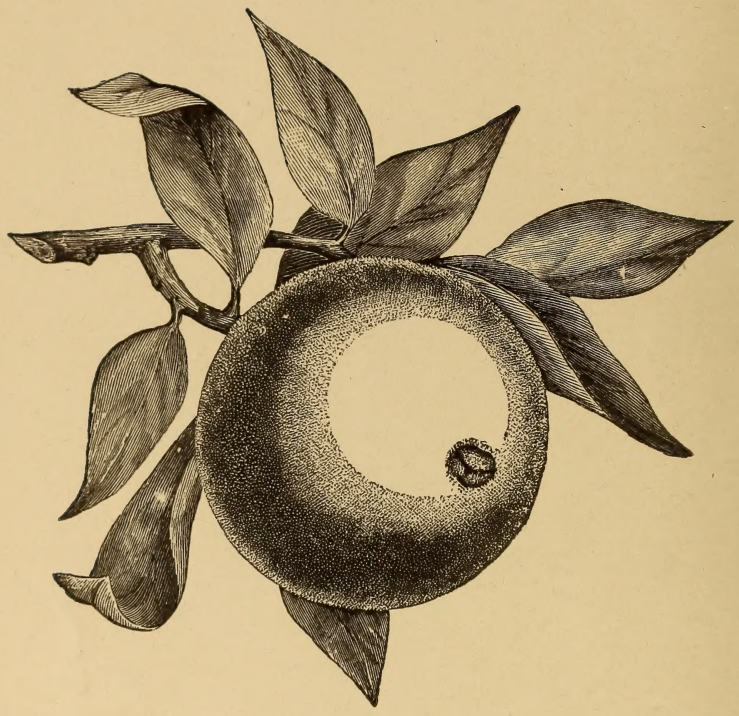
THE ORANGE:

ITS CULTURE IN CALIFORNIA.

WM. A. SPALDING.



NAVEL ORANGE.

"Orange Culture affords him both a Career and a Revenue."—BISHOP.

THE ORANGE:

Its Culture in California.

WITH

A Brief Discussion of the Lemon, Lime, and Other Citrus Fruits.

By WM. A. SPALDING,
Los Angeles, Cal.

ILLUSTRATED.

With an Appendix on Insects Injurious to Citrus Trees, and How to Combat Them.

[FROM THE WORK OF HON. MATTHEW COOKE.]

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THE HESPERIDES.

Where the sun goeth down in the West,
Where the spirits of earth find rest—
In the occident-land of the blest,—
There dwell the Hesperides.

They are daughters of Erebus—Night,
In vestments of shadow bedight,
And they know not the day with its light—
Those Sisters Hesperides.

They are guarding the apples of gold—
Earth's gift to fond Hera of old,
And their vigils forever they hold
O'er the fruit-laden trees.

And the spirits of earth and air
Know not that the Sisters are there,
Or the trees with their fruitage so rare
In that occident-land of peace,

For darkness is over them thrown:
Night claimeth the fruit for his own;—
Well he guardeth the Great Unknown,
With his shades, the Hesperides.

O glorious land of the West!—
O land I hold dearest and best,
Elysium is not then possessed
Of fruits so enchanting as these.

Thy groves that are ever in sight
Bear apples of gold not less bright,
And their guardians are angels of light,
Obeying the Day's decrees.

Blest mortals who there do abide!
Of the fruit that no shadows hide
They may eat and be satisfied,
Nor fear the Hesperides.

PREFACE.

These pages set forth my observations of the Citrus Fruit Industry during a residence of eleven years in Southern California, and my experience as a practical horticulturist for four years. The principles of propagation and planting I have worked out with my own hands, and know them to be more than abstract theories. In matters pertaining to the gathering, packing and shipping of fruit, I have discussed established methods, advocating the most advanced. I hope this treatise may prove a pleasant reminiscence to those of its readers who are experienced orange growers, and that it may aid the novice who lays hold of the orange tree to avoid the thorns.

W. A. S.

Riverside, Cal.

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PART I.

THE SUBJECT GENERALLY DISCUSSED.

THE ORANGE.

ITS CULTURE IN CALIFORNIA.

CHAPTER I.

A FEW OBSERVATIONS TO BEGIN WITH.

There is that about the cultivation of the orange which attracts people. Call it a glamour or what you will, the fact remains that many who have hardly given a second thought to horticulture their lives long, seeing the orange tree, fall beneath its spell, and become henceforth its most ardent devotees;—toiling for it, spending their money for it, waiting long and patiently for it, and even undergoing privations that they may possess it. I do not know that this subtle influence is capable of analysis; I only know that it exists. But sometimes in thinking upon this subject the fancy has struck me that the orange tree knows very well how to gauge a man—has the faculty, so to speak, of approaching him on every side at once.

Is he a lover of the beautiful? Then he must be delighted with its trim body and symmetrical branches; its dark evergreen foliage, with the yellowish new growth peeping out a-top; its bloom that rivals the tuberose in delicacy and fragrance; its fruit like apples of gold in pictures of silver.

Has he a fancy for out-door life? The tree invites him to share with it the fresh air and sunshine.

Does he possess the true horticultural instinct?—does he like to see things grow and make them grow? The orange rewards him doubly for every attention he bestows.

Does his grosser nature crave the good things of this world? No fruit is more luscious.

And finally, is there, underlying the poetry, the industry, the skill, the appetite of the man, a shade—just a shade—of cupidity? There the orange tree touches him again.

You see it has measured him very accurately; it knows his strong points and his weak points; it averages him and takes him for what he is worth. His own wife couldn't have done the thing better.

In most parts of the United States the tendency of population is toward the city. Not only does the farmer's boy leave the country to seek out the coveted clerkship, but the farmer himself, arrived at a comfortable affluence, is often disposed to move into town, either on the pretext of giving the children a better schooling, or that he may engage in trade, or because the farm labors and cares are too arduous for his years. In California the movement is in the opposite direction. People go from the city to the country. Our fruit colonies are filled up with retired professional and business men. In some instances they are men that have adopted farming as a sanitary measure; but again, many are to be found in their very prime and vigor who lead this life purely as a matter of choice. Some of them, possessed of wealth, education and refinement, seek

the country for the delights nowhere else to be found, surrounding themselves there with all the elegancies of a city home. And if upon occasion the rich man choose to pull off his coat and bear the brunt of toil, who shall say that he will not enjoy his dinner the better and sleep the sounder o' nights thereafter?

The field proves inviting to people of all classes and conditions. The young man, just starting out to make his way in the world, cultivates his trees and vines alongside the superannuated minister; and across the way is the farm of a lady who quit school-teaching because she tired of its drudgery. Many men who continue in business or professional practice in town have their villas in the suburbs, or their country homes of easy access, where they live beneath their own vine and fig tree, and cultivate their own orange. And if long-time residents are thus drawn away from the city, attracted by the charm of out-door life and the pleasure of horticulture in this semi-tropical climate, what wonder that many who come from the snow-bound East and North are captivated and impelled in the same direction!

Orange culture must continue as it has begun, an industry suited to the most intelligent and refined people. It is better adapted to small farms than large. It produces better results under the eye and hand of the master than when delegated to hired labor. As it requires both skill and industry, it gives healthful occupation to the mind as well as the body. While the growing of an orange orchard involves something of an investment, supplemented by several years of waiting, and no small amount of labor and care, the reward at last is ample. If one elect to bridge over the waiting and work by purchasing a grove already in bearing, he will have to pay pretty good wages to the man that built the bridge.

CHAPTER II.

A RETROSPECT, AND A QUESTION ANSWERED.

Will it pay to raise oranges? Yes, and no. It will pay to raise good fruit; it will not pay to raise poor. Simple as this proposition appears when reduced to print, it has taken a good many of us here in California a long time to find it out. While experience has already demonstrated that this survival of the fittest is inevitable, we will yet be compelled to acknowledge that it is reasonable and just. The time was, and not so long ago either, when many of our people rushed into orange growing as they would have rushed into a speculation in stocks. Carried away by the prospect of great rewards, they engaged in the industry blindly and recklessly:—planted orchards in localities not at all suited to them; planted scrubby or infested trees; planted beyond their means; planted without a knowledge of orange growing, and sometimes with no natural taste for horticulture; planted, planted, planted anywhere, anyhow, anything, if only they might possess themselves of an orange grove.

Taking advantage of this furor, the few nurserymen that carried citrus stocks put their prices up to a dollar or two a tree, sold out, got rich. Then the frenzy of speculation extended to the propagation of orange seeds for relays of nurseries, and a wider extension of plantations. Nursery projects were inaugurated, ranging through every degree from the hundred-acre joint stock enterprise to the row of oyster cans which *materfamilias* established in the back yard to augment the family income. From this planting came trees that were good, bad and indifferent, of course, but the average was, if possible, worse than the preceding supply. And when this heterogeneous stock was fairly on the market,—then the deluge; or rather, the contrary.

The dry season of 1876–7 came on, followed by the wave of hard times which swept across the country. People who had planted on insufficient capital were the first to feel the pressure. Many were obliged to surrender their places. Joint-stock nursery projects failed. Some nurserymen sold out, or were closed out, and left the country. Thus the furor of orange planting received a check. Nursery stock being of slow sale, began to fall under the operation of the law of the survival of the fittest. Most of the orange orchards already planted were too valuable to be abandoned, no matter what the fate of the planter might be, so somebody stepped in to carry them forward. Thus it was that, through all the times of depression and discouragement, the industry itself went steadily and surely forward. The unprecedented frosts which occurred in the winter of 1879–80, gave a rude awakening to some people who planted in low, cold places. Not only was the nursery stock frosted to the ground, but in many instances five and six-year-old trees were destroyed. The devastation among lemons and limes was even greater than among oranges. These frosts demonstrated that there were certain localities in this country not at all adapted to orange culture. Some people, a little more fortunate in their locations, managed to weather through the cold year, and even two or three cold years afterwards, but for them there still remained a rude awakening when they found that their trees, having reached the bearing age, were capable of producing only an inferior quality of fruit.

The season of 1882–3 was the most depressing for the orange industry that we have ever known. The trees set unusually full, and this alone had a tendency to dwarf the fruit and detract from its good qualities. Then there were late frosts so severe that some of the fruit was nipped, and its juices injured or totally destroyed. When the market opened the weather was cold and rainy, and people were in no mood for eating sour fruit. Prices went down. Some producers and dealers who shipped inferior oranges, in spite of the unfavorable outlook, found that they had their trouble for their pains and a freight bill to settle besides. Then it was that some superficial people began to inquire, "Will orange growing pay?" "Have n't we been deluded all this time in thinking it a remunerative industry?"

Those who got started right; who planted on high, warm, mellow soils; who took good care of their trees, and followed orange growing as an industry, not a speculation, are the ones who suffered no loss through the time of depression, and who are now firmly grounded in the belief that orange growing pays. Last season while the average oranges of the lower valley were going at a dollar a box, and a slow sale at that; while many trees hung full of little fruit, not salable at any price, I talked with an orange grower of Pasadena, who was sending off his large, luscious Washington or Riverside Navels, and realizing therefor $3.50 to $4 a box,— "And if I had a hundred thousand boxes," he said, "I could sell every one of them at these prices. Will orange growing pay? Well, I rather think it will. It is to-day the best enterprise a man can engage in."

CHAPTER III.

ANTIQUITY OF THE CITRUS FAMILY.

Over fifty years ago Gallesio wrote, in French, a learned work on "Citrus Culture," which, in more recent times, the Horticultural Society of Florida translated and published in English. Both original and translation are now out of print, and are only to be found in treasured collections. From this work I am able to glean some curious facts, as well as some very ingenious and erudite surmises about the earliest record of the citrus family.

Galleseo holds that the lemon and or-

ange originated in Southern Asia, and in that portion of the East Indies lying beyond the Ganges. Up to and including the earlier centuries of the Empire of the Cæsars, these fruits had not been brought from those climates where they were indigenous. They grew without culture in the native groves, the hand of man not having yet appropriated them as ornaments for his garden. The fruit was even unknown to the Romans, a people who in the age of their triumph sought out every luxury which the world of their conquest afforded. Pliny, in the account of his Indian voyage, makes no mention of either orange or citron. Other writers on this region, such as Nearchus, one of Alexander's captains, and Arianus and Iambolus are equally silent on the subject of citrus fruits.

To the Arabs who, under the leadership of Mohammed, extended their conquests into Asia and Africa much faster than any people before them, belongs the credit of first disseminating the orange. They acclimatized the trees in Syria, Africa, Spain and some European islands. Occupying a position advantageous and favorable to the commercial spirit and love of luxury which succeeded the fury of conquest, the Arabs naturally learned of and appreciated many exotic plants peculiar to the regions they had conquered or to adjoining countries. They were fond of medicine and agriculture, in which they especially excelled. To them we owe the knowledge of many plants, perfumes and Oriental aromatics, such as musk, nutmegs, mace and cloves. In their medicines we for the first time hear of the chemical change known as distillation, which appears to have originated in the desire to steal from nature the perfumes of flowers and aroma of fruits. It is certain that the orange was known to their physicians from the commencement of the fourth century of the Hegira. The Damascene has given in his Antidotary a recipe for making oil of oranges and their seeds (*oleum de citrangala et oleum de citrangulorum seminibus*). Another Arabian physician, Avicenna, employed the juice of the bigarade (bitter orange) in a medicinal syrup which he called alkedere. The orange was from the first valued not alone for the beauty of its foliage and quality of its fruit and for its medicinal uses, but also for the aroma of its flowers, of which essences were made.

Abd-Allatif, an Arabian writer of the twelfth century of our era, says: "The round citron (*otrodj modawar*) was brought from India since the year 300 of the Hegira (A. D. 922). It was first sowed in Oman (part of Arabia), from thence carried to Irok (part of old Persia) and Syria, becoming very common in the houses of Tarsus and other frontier cities of Syria, at Antioch, upon the coasts of Syria, in Palestine and in Egypt. One knew it not before, but it lost much of its sweet odor and fine color which it had in India, because it had not the same climate, soil and all that which is peculiar to that country."

The lemon appeared perhaps a little later in these different countries, for we see no mention of it either in the Damascene or in Avicenna, but its description meets the eye in works of Arabian writers of the twelfth century, especially Ebn Beitar, who gave it an article in his dictionary of simple remedies.

The Arabs invaded Sicily about the beginning of the ninth century, and planted the orange tree in that island. The citrine apples of Leon d'Ostia date from 1002, and were regarded as objects rare and precious enough to be offered as gifts to princes. Nicolas Specialis, in his history of Sicily, written in the fourteenth century, recounting the devastation by the army of the Duke of Calabria, in 1383, in the vicinity of Palermo, says that it did not spare even the trees of sour apples (*pommes acides*), called by the people *arangi*, which had adorned, since old time, the royal palace of Cubba.

After the Arabians, the Crusaders were the next agency for the extension of citrus culture. They entered Asia Minor as conquerors, and thence spread themselves as traders into all parts of Asia. They were not mere soldiers, but brave men drawn from their families by religious enthusiasm, and who, in consequence, would hold fast to their country and their homes. They could not see without coveting these charming trees which embellish the vicinity of Jerusalem, with whose exquisite

fruits nature had favored the climates of Asia.

It was at this time that Europe enriched its orchards by many of these trees, and that the French princes carried into their country the damson, the St. Catharine (a pear), the apricot from Alexandria, and other species indigenous to those regions. Sicilians, Genoese and Provençals transported to Palermo, St. Remo and Hyeres lemon and orange trees. Jaques de Vitry, a historian of the thirteenth century, who had been in Palestine with the Crusaders, and who accordingly speaks *ex cathedra*, has this to say of the subject: "Besides many trees cultivated in Italy, Genoa, France and other parts of Europe, we find here (in Palestine) species peculiar to the country, and of which some are sterile and others bear fruit. Here are trees bearing very beautiful apples—the color of citron—upon which is distictly seen the mark of a man's tooth. This has given them the common name of *pomme d'Adam* (Adam's apple); others produced sour fruit, of a disagreeable taste, which are called *limons*. Their juice is used for seasoning food, because it is cool, pricks the palate, and provokes appetite. * * * There is a species of cedar called *cedre maritime*, whose plant is small but productive, giving very fine fruits as large as a man's head. Some call them citrons, or *pommes citrons*. These fruits are formed of a triple substance, and have three different tastes. The first is warm, the second is temperate, the last is cold. Some say that this is the fruit of which God commanded in Leviticus: 'Take you the first day of the year the fruit of the finest tree.' We see in this country another species of citrine apples, borne by small trees, and of which the cool part is less of a disagreeable and acid taste; these the natives call *orenges*."

From Naples and Sicily the orange and lemon trees must have been carried into the Roman States, into Sardinia and Corsica and to Malta. The islands of the Archipelago first received them, because, belonging in great part to the Genoese and Venetians, it is probable they were the intermediate points whence the Crusaders of Genoa and Venice transported the plants to their homes.

The use of the lemon as seasoning for food, brought from Palestine to Liguria, to Provence and to Sicily, penetrated to the interior of Italy and France. The taste for confections was propagated in Europe with the introduction of sugar, and this delicate food became at once a necessary article to men in easy circumstances, and a luxury upon all tables. It was above all as confections that the Agrumi (lemons) entered into commerce, and we see by the records of Savona that they were sent into cold parts of Italy, where people were very greedy for them.

After having cultivated these species for the use made of their fruits, they soon cultivated them as ornaments for the garden. The monks began to fill with these trees the courts of their monasteries, in climates suited to their continual growth, and soon one found no convent not surrounded by them. Indeed, the courts and gardens of these houses show us now trees of great age, and it is said that the old tree, of which we now see a register in the court of the convent of St. Sabina at Rome, was planted by St. Dominick about the year 1200. This fact has no other foundation than tradition, but this tradition, preserved for many centuries, not only among the monks of the convent, but also among the clergy of Rome, is reported by Augustin Gallo, who, in 1559, speaks of this orange as a tree existing since time immemorial. If we refuse to credit its planting to St. Dominick, we must at least refer it to a period soon after—that is, to the end of the thirteenth century, at the latest.

In their spread among the most civilized peoples of the earth the orange and lemon finally penetrated into the colder latitudes, and perhaps we owe to the desire of enjoying their flowers and fruit the invention of hot-houses, afterwards called in France *orangeries*. This agricultural luxury was unknown in Europe before the introduction of the citron tree. In the fourteenth century people had begun to erect buildings designed to create for exotic plants an artificial climate. But at the beginning of the fifteenth century orangeries passed from king's gardens to those of the people, chiefly in countries where they were not compelled to heat

them by fire. About the middle of the seventeenth century this luxury was very general, and we see distinguished by their magnificence and gradeur the orangeries of the Farnese family at Parma; of the Cardinal Xantes, Aldobrandini and Pio at Rome; of the Elector Palatine at Heidelberg; and of Louis XIII in France. In all the civilized parts of Europe the orangerie is now considered an embellishment necessary to all country seats and houses of pleasure.

In nomenclature oranges and lemons had a most difficult time in establishing themselves. The lemon tree, first brought into Egypt as a variety of citron, was for a long time designated by European writers under the generic name of *citrus*, although in Italy and the south of France the people had known it from the beginning by the name of *limon*. We find in botanical works *citrus limon* or *mala limonia* and sometimes *citrus medica*.

In Arabia the word first applied to the orange was *arindj*. This in Syria was modified to *narengi*.

The orange appeared in Italy under the name of *orenges*, which the people modified, according to the pronunciations of the different sections, into *aringo*, *naranzo*, *aranza*, *aranzo*, *citrone*, *cetrangolo*, *melaranco*, *melangolo*, *arancio*. The Provençals also received this tree under the name of *orenges*, and have changed it from time to time, in different provinces, into *arrangi*, *airange*, *orenge*, and finally, ORANGE.

During several centuries the Latin authors found themselves embarrassed in designating this fruit, which had no name in their language. The first who spoke of it used a phrase indicating its characteristics, accompanying it with the popular name of *ārangi*, Latinized into *orenges*, *orangias*, *arantium*. Jaques de Vitry calls oranges *poma citrina*, adding, "The Arabs call them *orenges*." Nicolas Specialis designates them as *acri pomorum arbores*, observing that the people call them *arangias*. Mathews Silvaticus first gave to the orange the name of *citrangulum*. This last designation was received in the language of science for more than a century. Finally, little by little, were adopted the vulgar Latinized names in use among other writers, such as *arangium*, *arancium*, *anarantium*, *nerantium*, *aurantium*, *pomen aureum*.

The Greeks followed in the same steps. They have either Grecianized the name of *narenge*, which was in use among Syrian Arabs, or they received it from the Crusaders from the Holy Land; and have adopted it in their language, calling it *neranzion*.

In this day and age we are satisfied to call the fruit in English ORANGE and LEMON; in French, *orange* and *citron;* in German, *orange*, *citrone;* in Spanish, *naranja*, *limon*.

CHAPTER IV.

INTRODUCTION OF THE ORANGE IN CALIFORNIA.

Father Palou, the historian of the early California Missions, says:

"On the 10th of August [1771] the Father Friar Pedro Cambon and Father Angel Somera, guarded by ten soldiers with the muleteers and beasts] requisite to carry the necessaries, set out from San Diego, and traveled northerly by the same route as the former expedition for Monterey had gone. After proceeding about forty leagues they arrived at the river called Temblores [the Los Angeles river], and while they were in the act of examining the ground in order to fix a proper place for the mission, a multitude of Indians, all armed and headed by two captains, presented themselves, setting up horrid yells, and seeming determined to oppose the establishment of the mission. The Fathers, fearing that war would ensue, took out a piece of cloth with the image of our Lady de los Dolores, and held it up to the barbarians. This was no sooner done than the whole were quiet, being subdued by the sight of this most precious image; and throwing on th

ground their bows and arrows, the two captains came running with great haste to lay the beads which they brought about their necks at the feet of the sovereign queen, as proof of their entire regard; manifesting at the same time that they wished to be at peace with us. They then informed the whole of the neighborhood of what had taken place; and the people in large numbers, men, women and children, soon came to see the Holy Virgin; bringing food which they put before her, thinking she required to eat as others. In this manner the Gentiles of the mission of San Gabriel were so entirely changed that they frequented the establishment without reserve, and hardly knew how much to manifest their pleasure that the Spaniards had come to settle in their country. Under these favorable auspices the Fathers proceeded to found a mission with the accustomed ceremonies; and celebrated the first mass under a tree on the nativity of the Virgin, the eighth of September, 1771."

In the order of establishment San Gabriel was fourth among the missions of Upper California. By reason of its rich soil and abundance of water, and its large number of neophytes brought into service, it soon advanced to the front rank in productiveness and wealth.

At San Gabriel Mission was formed the nucleus of California orange-growing. As to the time and circumstances of the first planting, history is silent. The archives of the Mission church, which alone could be accepted as absolute authority, are lost. Tradition even is not much to be relied upon among that class of people who have lived longest in and about the Mission. An old gardener, whom the writer found in the Mission orchard on the occasion of a recent visit, shrugged his shoulders in the aggravating, non-committal way of his race when questioned as to the age of the trees.

"*Tienen multos, multos anos, Senor!*" They are many, many years old, sir. I don't know how many. I think more than seventy. He underestimated their years.

Father Bot, the priest of the Mission, fixes the planting of the first orange orchard at about the year 1804. The present church building was erected in that year, and, reasoning from analogy, he concludes that the site of the grove must have been chosen with reference to the building. He thinks the trees were propagated from seed brought from San Rafael in Lower California.

Col. J. J. Warner, our "oldest inhabitant," settled in Los Angeles county in 1831. At the time of his coming the orange trees in the Mission garden were twenty-five or thirty years old and had long been in bearing. This agrees with Father Bot's calculation as to the time of their planting.

Three several Fathers Sanchez administered the affairs of San Gabriel Mission at different periods, and to the first of these, Father Tomas, belongs the distinction of introducing the orange. That he had an abiding faith in the success of his horticultural venture is attested by the fact that he imported iron with which to enclose the orchard. This iron, however, was never used, owing probably to the death or removal of the enterprising Padre, and after rusting in uselessness for some years at the Mission, a portion of it was purchased by Don Luis Vignes (1834) and brought to the city of Los Angeles. Here it was used to enclose the second orange orchard in the State. It is said that Don Luis procured from the Mission thirty-five large trees, which he transplanted to his place on Aliso street, near the historic Aliso (sycamore) tree, from which the street derives its name. He established at first a sort of exotic garden, enclosing his clump of oranges tightly and roofing the space with wire-netting. Within the enclosure he kept a flock of quail. Later, the Don increased the number of his trees until he was the possessor of a considerable grove. But he did not follow his expensive method of fencing and roofing throughout.

Other orchards followed. The most notable was that of William Wolfskill, planted in the city of Los Angeles, seven years after that of Don Luis Vignes. There was another four or five miles north of the Mission, known as *La Huerta del Cuate*, The Garden of the Twin, which, with one or two intermediate transfers, finally passed into the hands of Don Benito Wilson,

by whom it was carefully nurtured and extended by new plantations.

But between the planting of the original orchard at the Mission San Gabriel and the several groves above mentioned a long period must have transpired — perhaps twenty or twenty-five years, during which the Mission orchard was the sole representative of this fruit in California. Even after the extension of the industry, for many years oranges held no place among the recognized products of the country. Mr. Alexander Forbes, who wrote one of the earliest works on California—a book printed in England in 1835—cites wheat, maize, barley, pease, beans, potatoes, hemp, grapes, olives and grasses as the principal crops, but makes no mention of oranges.

Ex-Governor John G. Downey, writing of the early cultivation of the orange, says:

"In those days, though there was plenty of energy and intelligence among the Spanish pioneers, it was a difficult undertaking for the ranchero to build a fence to protect his orchard from the multitude of wild stock that surrounded him, even to the door of his pueblo home. * * *

"The orchard of orange trees at San Gabriel was scarcely in bearing when Don Luis Vignes planted his orchard in Los Angeles. Next followed that of William Wolfskill, and next, that of Don Manuel Requena. These little orchards were enclosed by an adobe wall, as were those of the Missions of San Gabriel and San Fernando. Many of the old families followed these examples by planting a few trees in their respective court-yards. I can safely say there was not a tree planted with a view to profit, and not an orange sold until long after the advent of the Americans. The fruit was cultivated for home use, and for the use of friends less fortunately situated.

"In the year 1853 Matthew Keller and Dr. Halsey obtained seeds from Central America and Hawaii, and planted nurseries. Dr. Halsey's nursery was the most extensive. While this plantation was very young, the doctor was crossed in some love matters, studied Andrew Jackson Davis more thoroughly than he did Downing, and went off on a spiritual mission East, leaving his nursery in care of Judge I. S. K. Ogier. The latter sold the nursery for a song to William Wolfskill, whose place was adjoining, and the orchard now the property of Miss Francisca Wolfskill is the result. It is a very pretty property—perhaps the largest bearing orange orchard in the United States. At least I have not seen any as large in Florida, Louisiana or Cuba. It is a pleasure to look at, is a source of great profit, and could not be in better hands.

"The orchard of Mr. Wilson was once a portion of the Mission of San Gabriel. In the unconstitutional sale of the missions this portion fell to Hugo Reed. Mr. Wilson bought it in 1852 of Reed's widow. There were then on the place several fruitful trees, which are still in vigorous bearing, and will be for several generations. Mr. Wilson has industriously and intelligently added to them; not at any great cost, for he raised his trees in his own nursery, and continues to raise them, so that he has them always on hand without expense."

The orchard of William Wolfskill, alluded to above, was no doubt the first that was planted in California with an idea of profit. Mr. Wolfskill's neighbors ridiculed him, saying that he would get no fruit in his lifetime. It was a severe trial of patience to maintain the trees through all the years requisite to bring them into bearing, and all that for a mere experiment. At the same time vineyards of three or four years' growth were paying handsomely, with no more labor. This fact came near tipping the balance against the trees, but Mr. Wolfskill's German tenacity finally prevailed, and the trees were brought to fruition. He lived to enjoy his oranges for twenty years, and they gave him, some years, an income of a thousand dollars an acre. The last crop disposed of in his lifetime from about twenty-eight acres sold on the trees for $25,000.

From 1857 to 1862 orange-growing was greatly checked by the insects, which caused an almost total failure of the fruit. But in 1862 this pest abated, and there was a good crop. There were then in the whole State only about 25,000 trees, two-thirds of which were in the Wolfskill orchard.

Since 1862 the spirit of modern progress has been infused into orange-growing, and the area of plantations has increased with marvelous rapidity. In 1880 the entire number of orange trees in the State was estimated at one million, a quarter of which were in bearing. In 1882 the bearing trees had increased to half a million. The ratio of increase for the years 1883 and 1884 has probably been fully as great, and, at this writing, we may say there are a million trees in the State that are yielding oranges.

The original orchard of Father Tomas Sanchez, of blessed memory, still remains in the Mission garden at San Gabriel. It is a decrepit old patriarch still lingering to witness the glory of its tribe. The inclosure comprises about six acres, and it is probable that 400 trees constituted the original plantation. Of this number less than thirty survive. I wish that I could say that these trees, now more than eighty years old, remain in a fair state of preservation, but they do not. Few of the trunks are sound. Some of them appear half or two-thirds dead, and only a narrow margin of live bark and wood to keep vigor in the top. Some have a water-sprout growing from the old trunk with all the thrift of youth, the sprout itself in a number of instances having attained the proportions of a tree. One of the old trunks that I measured showed a girth of forty-two inches near the ground. Three or four years ago the old trees were topped, probably as a restorative measure. They now boast new tops of respectable dimensions, but the trees possess something of a stubby appearance, nevertheless. It is a matter of record that, before the topping process, one of the old trees bore in one season 10,000 oranges. The trees are now bearing from the new growth, and the fruit is a good quality. The spaces between the patriarchs, which were made vacant by those that were gathered to their fathers, have all been filled by younger trees. Some of these replants are now full grown—probably twenty-five years old, and others younger. The orchard, in the main, presents an incongruous appearance, with young, middle-aged and old trees intermingled. The well-meaning Father who replanted probably did not bear in mind the Scriptural injunction about putting new wine into old bottles, and mending an old garment with new cloth.

The Mission orchard and garden is farmed out to a tenant (Mexican), who cares for it and takes a part of the crop for his pay. While the orchard is fairly tended at present, it shows evidences of great neglect in former times. Probably its long and eventful history has been an unbroken succession of over irrigation and under cultivation. Hence the diseased condition of the trunks. Some of the patriarchs must bow to the inevitable in the course of a few years. Others promise to round up their century of existence, and perhaps more.

CHAPTER V.

A GLANCE AT OUR ORANGE-GROWING COUNTRY.

"All Gaul," says Cæsar, "is divided into three parts." The same is true of all Southern California. But our tripartite division, unlike Cæsar's, is based upon topography.

If you were at the masthead of a vessel off the coast of Los Angeles county, you might have these three grand divisions within your range of vision. Looking up the perspective of Wilmington inlet you would descry the low, half-marshy country behind Wilmington. At the left of the view the headlands of Santa Monica indicate the upland plain lying beyond. The mountains of the Coast Range form the background of this plain, and at their base you perceive there is an irregular, sloping strip of land, forming the line of junction between the mountains and the plain. This intermediate land here, as

elsewhere in California, we designate by the Spanish word *mesa*, meaning table.

You have seen, then, from your masthead, the lowlands of Wilmington, the uplands of Santa Monica, and the mesas of the Coast Range. These are types of the three natural divisions of our country. Though comprehended in the same geographical area, and often found contiguous, they still vary in characteristics of soil, climate and productions as much as distinctive countries. Prof. Hilgard says:

"They are commonly distinguished into lands of the first bench, or bottom lands of the streams; lands of the second bench, forming either at the present time or originally a system of terraces elevated from fifteen to twenty-five feet above the bottom lands; and, finally, the mesa lands, lying at higher elevations, and with no definite relation to the present drainage system. Of course, these distinctions are not absolutely maintainable; the second benches and lower mesa lands passing into each other imperceptibly, especially on the upper portions of the streams, while again, in the lower portions of the same, the second bench lands often lie high enough to be classed as mesas. On the slopes of the mesa lands the soil of the latter and that of the bench lands are of course frequently commingled."

I have cited portions of Los Angeles county by way of illustration, while specifying the general characteristics of Southern California. The principles which these chapters are designed to illustrate apply to all that portion of California lying south of Point Concepcion. They also apply, measurably, to all other agricultural sections of the State, and to all fruit-growing countries in the world, so far as I am able to judge from published reports at my command.

CHAPTER VI.

THE LOWLANDS.

Our lowlands may be described, in brief, as the troughs of the natural watersheds. They occur in the line of greatest depression in the valleys, between mountain chain and mountain chain, and receive whatever surface drainage there may be. Their principal source of moisture, however, is in the subterranean flow. These lands abound in *cienegas*—marshy flats—and the water is anywhere obtainable a few feet below the surface. Generally speaking, our lowlands are not unlike the so-called "bottoms" of the Missouri and Mississippi rivers. The soil is a rich loam, and in some places quite sandy. Willows grow in dense, natural thickets, and cottonwoods are occasionally found. Some sections, too damp and alkaline for anything else, produce a species of salt grass. Where the configuration insures sufficient drainage, these lands produce amazing crops of corn, beets, pumpkins, alfalfa, etc. Small grains are apt to grow too rank for the best results. With proper tillage, the farmer may here defy that bug-a-boo, the California "dry year," since the moisture to mature his crops is supplied unfailingly from below.

But while this lowland belt excels in the products mentioned, to the extent of being facetiously dubbed "our hog and hominy country," it is not well adapted to horticulture. I except apples and English walnuts, which thrive there, better perhaps than in other localities. Peach, pear, and other deciduous trees grow, but the fruit, while frequently of great size, is watery and insipid.

On such land were doubtless produced those California pears which Bret Harte stigmatized as "great and dropsical." The more shame to him as a quondam Californian, for abusing our fruits without discrimination! But many people have fallen into the same error; hence the widely prevalent belief that California does not produce fine-flavored deciduous fruits. Those ponderous lowland pears are designed to feast the eyes, not the palate; and the Eastern man who buys them

—delivered in his market at their weight in nickels—and in good faith *eats* them is probably excusable for his after prejudice against California fruits.

The reason why the lowlands are not well adapted to horticulture is found in the damp, cold condition of the ground. To what extent this difficulty might be obviated by a thorough system of underdrainage, like that in vogue among Eastern and Old World farmers, it is impossible to state. So far as I am informed, nobody has tested the method; and, unfortunately, our lowland farmers are not of the class that expend any of their substance in experiments.

However they may continue to offend the Eastern palate with their big, tasteless pears and peaches, there is no danger that they will scandalize our citrus fruits. Oranges, lemons and limes cannot be profitably grown on the lowlands. Not only is the cold soil against them, but the air temperature also goes below their limit of endurance. I can only give a hint at the theory of atmospheric strata, which accounts for the seeming anomaly of the greater warmth existing in the higher alitudes. Suffice it that cold air being more dense than warm is heavier, and hence sinks to the lowest parts of the valley and establishes its level just as an equal volume of water would do. In our country the cold spells are not of sufficient intensity or duration to raise this sea of chilled air above a certain level. As the cold currents flow down from the snow-capped mountain peaks, they seek the channels of greatest depression, and the warm atmosphere of the day rises upon the surface of the invisible flood. The high grounds escape this inundation; hence their greater freedom from frosts. This is not a mere hypothesis, but a well-established physical condition which is demonstrated nightly through nearly the entire year. In winter it is possible to find a difference of fifteen or twenty degrees between the temperature of the high and low lands. In ascending from the valley I have many times noted the transition from a colder to a warmer stratum of air, and have even taken cognizance of three such strata in making the elevation of two hundred feet. In such cases the change is as great and as sharply defined as one would experience in passing from a cold bath to a warm one.

It has been truly said that a man might as well try to raise oranges in Greenland as in some portions of Southern California. While the object of these articles is mainly to point out the situations favorable to orange growing, it is also within their province to say where oranges may not be grown. The lowlands should be avoided.

CHAPTER VII.

THE MIDDLE LANDS.

The uplands, classified as the second grand division of the country, constitute our great body of agricultural and horticultural lands. As regards soil, elevation, water supply, and all leading characteristics, these uplands are greatly diversified. They are, therefore, adapted to a wide range of products, and, in one place or another, they yield everything that is grown in the country. And it is enthusiastically claimed that we have every product known to the sub-tropical and temperate zones, and some that are peculiar to the torrid and frigid. It was mainly upon the broad expanse of these uplands that Los Angeles county produced in 1882 her 1,700,000 bushels of wheat and 729,090 bushels of barley; her fruit crop to the value of $950,000, and the grapes from which were manufactured 3,100,000 gallons of wine and 145,000 gallons of brandy.

It should be understood that I include in the category of uplands not only the broad plain of the Los Angeles valley, but also the tributary valleys, which are mainly devoted to grain. These lands produce

wheat and barley without irrigation, and during the past five years have averaged good yields. Latterly it has been demonstrated that the vine may also be grown here without irrigation, and thousands of acres, previously considered fit only for grain, have been transformed into vineyards. For general farm products and fruits, however, irrigation is necessary.

Oranges are produced on the uplands with varying results, which may be termed good, bad and indifferent. In proximity to the ocean, the orange tree does not thrive. As the valley recedes, gaining continually in altitude and modifying the sea breezes, the chances for successful orange culture increase. Two years ago it would have been an act of treason for me to say that the best flavored oranges could not be grown in and about the city of Los Angeles, twenty miles from the coast. But it is even so. All unprejudiced observers, and some that are prejudiced, are forced by the logic of market quotations to acknowledge the fact. Last season Los Angeles fruits were sold by our jobbing houses and hucksters at half, or less than half, the prices commanded by the oranges of Pasadena and Duarte (mesas), and of the far interior valley of Riverside, in San Bernardino county.

I have said that the chances of success in orange growing increase as the valleys recede from the ocean. The favorable conditions culminate in the high interior irrigable valleys like that of Riverside, where the soil is warm, and the weather hotter in summer, and more tempered in winter. The oranges of Riverside rate as the finest grown in the State, and command the highest prices. The same favorable conditions are found on the mesas which lie against the Sierra Madre mountains on the south, southeast and southwest. Here the atmosphere is warmer by reason of the greater elevation, and the earth absorbs heat both from the direct rays of the sun and the refraction from the mountain sides. This brings us to the consideration of what I have termed the third natural division of our country.

CHAPTER VIII.

THE MESAS.

Less than twelve years have elapsed since the settlement and improvement of our mesas began. During the first half of this time the general public looked askance at the few venturesome people who had set out to demonstrate that these lands were really arable. When success was finally secured, the press took up the matter and agitated it so persistently that a general change of opinion was soon effected.

That the advantages of the mesas for fruit growing, and especially for orange growing, were so tardily recognized is a matter of wonder. A man with "half an eye" should have observed their natural adaptability to horticulture at the outset.

The early settler in Los Angeles county found the upper valleys mostly a treeless and shrubless waste. The only vegetation there abounding was the alfilerilla, that hardy cousin of the geranium, which matures its seed whether the stalk grows to a height of three feet or a half inch—thus allowing the utmost latitude for wet and dry seasons, and perpetuating itself where scarcely any other vegetation could survive. This alfilerilla the early settler found dried and matted upon the ground a good half of the year. In marked contrast with the semi-sterility of the plain, the foothills presented a perennial covering of verdure. There, through the long, dry summer, the lupine and larkspur sent up their spikes of bloom, and the sage and grease-wood, the alder, white thorn and buckthorn blossomed and matured their seeds and fruit. In some localities, too, there were vigorous growths of live-oaks and sycamores.

Now, what did the early settler do but locate his farm upon the treeless and shrubless plain, where he applied himself to the raising of an orchard and vineyard

by irrigation! And he imbibed a notion, somehow, that the foothills were dry and sterile. This prejudice existed for a hundred years. Not only did the original settler maintain it faithfully to the end, but his sons and his sons' sons, to the third and fourth generation.

Our comparatively recent discovery that the foothills offer desirable lands for fruit culture is, in reality, no discovery at all. The viticulturists of the old world have known the fact and have taken advantage of it for many years. In France, the most celebrated vineyards—Chateau Marguax, Chateau Leoville, Monte Bello, Cliquot, and many more—are located on the summit or sides of eminences. In Germany, Johannisberg and other noble wines are produced on the Rhine hills. Spain was the last among European countries in discovering the natural advantages of the highlands, and when the fact became patent some of the more desirable locations advanced in value a thousand per cent.

For fruit trees as well as for vines the elevated lands are in request in France and Spain, and in Mediterranean countries. Substantially the same fruits that excel in our higher altitudes excel in the higher altitudes in France.

Gen. H. S. Sanford, of Florida, writing of citrus culture in Sicily, says: "The richest soil does not produce the most esteemed fruits. Thus, in the vast and fertile valley of the Concho, back of Palermo, covered with orange groves of most luxuriant growth, its productions sell for one-third less than those of the same trees planted on Monte Reale, and other hills in sight, with poor, calcareous soil; and whose fruits, prized especially for export, by reason of their quality of long keeping, are known by the mark 'M' (Mountain)."

It is thus shown that the prejudice of the pioneer fruit grower against our foot hills was opposed to precedent as well as to good judgment. Having eyes, he saw not the proofs set before him by nature in the wild growth of trees and shrubs, and, having ears, he heard not the testimony of other peoples. Suffice it that the century-old prejudice having at length been dissipated, fruit and vine growers throughout the State have been making seven-league strides to recover the lost territory.

CHAPTER IX.

STATUS OF THE ORANGE INDUSTRY.

The orange tree is not indigenous to Southern California. Neither can it exist here in a wild, untended state. Perhaps these circumstances, seemingly disadvantageous, are really points of strength, when we consider that personal exertion supplies every deficiency.

Mankind—especially the mankind of this soft, sub-tropical clime—is somewhat predisposed to "take things easy." Humor his laziness a little, and he becomes lazier still. If our not-too-energetic early settlers had found that by simply dropping the seed, they might grow thickets or oranges in the fence corners and by the roadsides, depend upon it, there would have been wild fruit enough to supply every demand. But with such a condition of affairs, the incentive to careful modes of cultivation would have been lacking, and to this day our people might have contented themselves with a profusion of inferior fruit, unable to command any extended market, and oblivious to the great possibilities of the orange-growing industry. Such, indeed, is the case in Central and South American countries, which have been endowed by nature with all our advantages and with the *disadvantage* of growing the fruit without personal effort.

Our cultivators, obliged from the outset to give their trees close attention, and admonished that the profits would be gauged by the thoroughness of their work, have addressed themselves to mastering every

detail of the industry. They have studied the requirements of their trees; have informed themselves of the most scientific methods of propagation; have introduced, by budding, the choicest known varieties; have mastered the problem of insect pests; have established markets, and are working to gain a reputation for their fruit. In those points to which they have earnestly and systematically devoted themselves, it is doubtful whether they are excelled by any orange-producing country in the world.

In two essentials, however, they are still lacking: 1st—manuring the soil; 2nd—preparing and packing the fruit.* But a reading, thoughtful, progressive people will not take long to discover and remedy their lapses.

Compared with horticulture as pursued in other portions of the United States, our section occupies a leading position. The system of seeding an orchard to grass or clover, or the lack of system in allowing the ground to grow up with weeds—which one sees so generally followed in other States—is not in vogue among our cultivators. On the contrary, the finest tilth and the utmost freedom from weeds and grasses is maintained, both in citrus and deciduous orchards. It would not be a difficult matter to show hundreds of fruit farms, varying in size from ten to fifty acres, which are as carefully tended as the finest flower garden.

Some people of poetical temperament complain of the absence of greensward in our orange groves, declaring that only this is lacking to complete the romance of the situation. But in this day and age romance is obliged to retire before utility. Scientific culture demands that soil devoted to trees shall not be exhausted by other vegetable growth; also that the surface of the ground be at all times finely pulverized in order to retard evaporation. Our system of fruit growing conforms to these requirements.

For a time—I refer to the period between 1870 and 1880—citrus culture presented here the spectacle of a great industry run mad. In a preceding chapter I referred to the furor for planting which then existed, and I also alluded briefly to some of the disastrous results which followed. Those years inculcated some useful lessons. They taught us that well established precedents and natural conditions can not be ignored and defied. They taught that success is attainable only by working *with* Nature, not *against* her.

And now, chastened, humbled, punished for our previous thoughtlessness and wrong-doing, and likewise rewarded for carefulness and right-doing, we proceed with more confidence and more integrity of purpose than ever before. With precedents well established, and authentic information disseminated on every questionable point, a man who takes pains to inform himself may now attain success in orange culture as surely as the sea captain who consults the chart may make his port. Of course, unforseen accidents may happen to either captain or orange-grower, but of the two the "land-lubber" enjoys the greater immunity.

The report of the Surveyor-General of California for the fiscal year 1881-2 gives the following statistics:

	Number of Bearing Lemon Trees.	Number of Bearing Orange Trees.
Los Angeles county	48,350	450,125
San Bernardino	3,749	15,435
San Diego	1,257	3,390
Santa Barbara	1,840	612
Santa Clara	547	1,635
Sonoma	1,893	3,927
Ventura	1,000	200
Yolo	.....	1,300
Butte	2,400	2,960
Scattering	1,094	4,643
Total	62,130	484,227

It was estimated that the number of trees not yet in bearing (which did not figure in the Assessor's reports) was three times the number of those in bearing, so that the grand total of orange trees in the State could not have been far from two millions.

Reports for the year 1882-3 are not available for any of the counties except Los Angeles. The Assessor of that county returns this year 526,640 bearing orange trees and 50,565 bearing lemon trees.

The entire crop of the State was, in the

*NOTE.—I should make an exception in Riverside, where the packing is done in a systematic and thorough manner.

season of 1881-2, twenty millions of oranges. San Francisco, which is our principal market, uses about twelve millions annually, of which over half are supplied by Southern California. In 1879 fifteen car loads of oranges were sent from Los Angeles to Salt Lake City, Utah, and from that time a good market has there been found. The rapid influx of people to Arizona during the past three or four years greatly increased the demand from that quarter. Arizona, by reason of the inadaptability of her soil to agriculture, the principal occupations of her people being mining and stock raising, and the excessive heat of her summers, is certain to continue a large consumer. Our market has also been extended within the past few years so that it includes Denver, Kansas City, St. Louis, Chicago, Cincinnati, Louisville, and all of the principal cities of the West and Southwest. Some fruit has found its way to the Atlantic States and some has been shipped to European countries, but not to the extent of forming regular channels of trade.

The number of oranges shipped by the Southern Pacific railroad from Southern California to Arizona, New Mexico, Utah, Colorado, and through points on the Missouri river and east thereof, from January 1st to July 1st, 1883, amounted to 131,450 boxes. By Wells, Fargo & Co., during the same time, estimated 20,000 more, making in all 151,450 boxes containing 30,290,000 oranges. To this amount we may add at least 10,000,000 more, shipped from July 1st to Dec. 31st, and at least 5,000,000 used up in local markets or destroyed in orchards, making for the crop, without counting those shipped to San Francisco 45,000,000 oranges. With the fruit raised in San Diego, San Buenaventura and Santa Barbara, there were probably 50,000,000 grown in the year 1882 and 1883. It is estimated that the annual increase from this time forward will be 10,000,000 a year. The crop, of 1883-4, if all put in boxes, would have required 250,000 boxes, and would have filled 700 freight cars at the rate of 350 boxes per car.

The remarkable keeping qualities of our oranges—due in a measure, no doubt, to their thick rind—renders their shipment long distances quite feasible.

The season at which our fruit ripens (December to March) and the length of time it may be allowed to remain on the trees without detriment (December to July) gives us great choice of market. Florida and Louisiana oranges are sold from November 1st to March 1st, and at the latter date the entire crop is gone. There is no necessity for marketing our fruit before February or March—and in fact it hardly attains its full size and sweetness until then—when we have the entire field to ourselves. Even the imported Tahitis are then out of the way.

As the lines of trade become better established, and the excellencies of our fruit more appreciated throughout the United States, the demand will, of course, greatly increase. It is fair to assume that, notwithstanding the prodigious increase of plantations, the market will never be overstocked with good fruit. Taking the season of 1883-4 for an example, I may state that as early as December 1st, when the fruit was only beginning to turn color, four-fifths of the crop of Los Angeles county had been engaged by jobbers. One cultivator sold his crop on the trees for the lump sum of $12,000. The usual price paid was $2 per box (average 150 oranges) and fancy lots went up to $2.50, $3.00, and ever $5.00 per box. That year's crop was accounted short—from half to two-thirds the normal yield—and the unusual promptness of purchasers was, of course, largely attributable to this fact. But, considering the increased number of bearing trees, and the increased capacity of some of the older ones, the yield was still very large. There is yet no substantial indication that the market is being over-supplied.

As the reader has already discovered by the perusal of the Surveyor General's table above given, the cultivation of the orange and lemon is confined to a few counties of California. Los Angeles county alone makes a showing in the above table of over forty-five forty-eighths of all the bearing trees in the State. I shall attempt to show, before concluding this treatise, that only a limited portion of Los Angeles and of the other orange-growing counties is adapted to the production of the better class of oranges. The area of

possible production is, then, very much restricted. While the market must continue to grow, and while the product will doubtless grow with the market, the area of possible production can not grow. At present ten oranges are imported to every one grown in the United States. The time is coming when our home product will, in a great measure, supplant foreign importations.

Prices may fluctuate somewhat, and may sometime rule much lower than they do now, but even at one-half of present quotations orange-growing must continue profitable. Growers in the Mediterranean accept one-quarter of our prices, yet they admit that they would find their groves profitable even at lower rates.

It is the firm belief of the writer that orange-growing in California will never be overdone, and, when rightly pursued, will never become unprofitable.

CHAPTER X.

PROFITS OF ORANGE CULTURE.

In his delightful book on Orange Culture in Florida, Rev. T. W. Moore says:

"When compared to the profit from other kinds of business, that derived from orange growing is so large that a statement of facts is often withheld because the truth seems fabulous to those who have only had experience with other kinds of fruit. Those engaged in the business consider each tree, as soon as it is in healthy and vigorous bearing, worth one hundred dollars. Indeed, the annual yield of such a tree will pay a large interest on the one hundred dollars. Now if we take into consideration that from forty to one hundred trees are grown on an acre, the yield is immense. In the quiet country, breathing its pure atmosphere, with fresh fruits and vegetables from January to January; mith milk, butter, honey and poultry, the product of his farm and accessories to his grove, the man who has once brought his trees into successful bearing can enjoy all these and much more besides, having at his command an income quite equal to that commanded by owners of blocks of well-improved real estate in our towns and cities, with not one-tenth part of the original cost of city investments."

This, let it be distinctly understood, was *not* written about California. Therefore, I have introduced it here. Before opening fire on this much bombarded question of orange culture, I wish to fortify myself with breastworks that shall be impregnable to the charge of local prejudice. My purpose is to show that another people, far remote, and following orange culture under conditions quite independent of ours, have arrived at the belief that orange culture is very profitable. We of California have worked through the same premises and arrived at the same conclusion. The proof is by two witnesses.

It is a difficult matter to present in business-like form the Profit and Loss account of orange culture in Southern California. It is a great industry, scattered and diversified. In one instance—pursued by a shiftless cultivator, or in an illy adapted locality, or lacking in other ways essential conditions of success—it may be a losing business. Again, with moderately favorable conditions, it may pay a small profit. And still again, with every circumstance in its favor, including a favorable turn in the market, the profit may appear prodigious. It would not be fair to cite either of these cases as illustrative of general results. It would not be fair even to strike an average of the three. Yet somewhere between the extremes a fair generalization is to be found. Reasonable excellence is, after all, a fair criterion. Let us incline towards results obtained from right conditions, careful culture, fair markets. Such results anybody can attain if he observes established methods.

Riverside is the model orange-growing settlement of Southern California. Here the conditions of reasonable excellence are

more general and uniform than in any other locality of like extent that I could name. Owing to the fact that statistics have here been carefully compiled, I am enabled to present something like a satisfactory view of the industry taken as a whole and averaged up by the acre. These statistics are drawn from the files of the *Press and Horticulturist*. Returns furnished by the cultivators in 1882 showed a grand total of 200,000 orange trees, covering 2,000 acres. The trees reported in 1882 may be considered as nearly all bearing at the present time—some at their best, others yielding their first or second crop, which is light. Some of the seedlings may not yet have come into bearing. Last year (1883-4), the total orange product of the valley was 25,000 boxes. The fruit then brought an average of $3 per box.

This year, the trees being more advanced and the crop generally fuller, it is estimated that the product will be from 100,000 to 150,000 boxes. Returns received from advance shipments range from $1 to $3.13 per box. These are net returns to the producers, free of any expense for picking, packing and shipping. The variation in prices is owing, in a great measure, to different qualities of fruit, the Riverside Navels and other choice budded varieties selling above the seedlings. Assuming $1.50 per box as an average price, the net income from 100,000 boxes of fruit would be $150,000. Or, taking the larger estimate of 150,000 boxes, it would be $225,000. These returns averaged upon the 2,000 acres devoted to orange culture, would give from $75 to $112.50 per acre as the net return. In this calculation, it must be remembered, enter the trees not yet bearing, others just coming into bearing and a small proportion in full bearing. Prices also range lower than ever before, with one exception, owing to the fact that our channels of trade are but just opening up, and as yet the means of disposing of so large a product are inadequate.

It is estimated that the orange crop of Riverside, when the trees are in full bearing,—say five years hence, should amount to five boxes to the tree, or 1,000,000 boxes. Allowing the price to be 75 cents per box (and it is hardly likely that fruit of the quality raised in the interior valleys of California will ever go below that figure), we shall have an aggregate net income of $750,000, or an average of $375 per acre.

These general estimates may seem overdrawn. Perhaps the inscrutable logic of events may prove them so. But I can assure my readers that the basis of calculation both in price of fruit and yield, are far below what is being realized in individual cases.

It is a matter of record, and has been cited in a preceding chapter, that some of the early cultivators realized profits which seem fabulous. Governor Downey says of Don Luis Wolfskill: "He lived to enjoy his oranges for twenty years, and they gave him, some seasons, an income of a thousand dollars an acre. The last crop disposed of in his lifetime, from about twenty-eight acres, sold on the trees for $25,000." The Don's sons and daughters, grown to mature years, still enjoy a princely income from the estate.

Six or seven years ago the profits of orange culture ran up to marvelous figures. In a speech delivered by Mr. J. de Barth Shorb to a public body, that gentleman stated that a single acre of Col. B. D. Wilson's older orange groves yielded nearly $1800 in one year, a fact which can readily be believed when single trees have been known to net sixty or seventy dollars, and when from sixty to eighty trees are planted to the acre. Three years ago Mr. Dalton netted $800 from a quarter of an acre planted in orange trees of a fine quality, and of mature growth.

In these times of increased production and lessened prices I do not know that any cultivator claims to equal the old Don's profit of $1000 per acre, or Col. Wilson's $1800. But it has been not unusual for a grower to clear as much as $500 an acre. In the season of 1882-3 one producer in the San Gabriel valley sold his crop on the trees for the lump sum of $23,000. This from about forty acres of orchard.

In the files of the *Press and Horticulturist* for October 25, 1884, I find the following:

"Mr. D. C. Twogood has 450 seedling orange trees, covering six acres of land. The trees were planted twelve years ago, and the roots were three years old when

the trees were planted, thus making the trees now actually fifteen years old. They have been bearing about six or seven years. It is from this six acres that Mr. Twogood expects to harvest 2000 boxes of oranges. He judges his crop this year from actual yields in previous years. He has, however, about sixty budded trees, now bearing lightly, in addition to the 450 seedlings, and possibly it may require a portion of this fruit to make up his estimate. He also has ten acres of budded orange trees that are just beginning to show fruit.

"He has obtained $3 per box, with the exception of one year—two years ago—when on account of the freeze he got only $2.25 per box. If he gets $3 per box this year, that will be $1000 per acre, which will pay ten per cent on an investment of $10,000 per acre, or something less after deducting running expenses.

"Regarding the cost of caring for a place, that depends upon circumstances. If a man has a five-acre tract, it costs him more to take care of it than it does if he has twenty or forty acres. A man can hire all the work done in an orange orchard for $30 per acre a year, but in addition to this work he must give a certain amount of personal care and attention not called for in the $30 per acre contract. If he expects to hire all the work done, but to supervise it in person, and do a little himself occasionally, $50 per acre ought to keep an orchard in good shape for one year.

"With this year's crop Mr. Twogood will have taken about $12,000 worth of fruit from his six acres in twelve years since planting—all of which, of course, has been within the last six years. The orchard has cost him something like the following figures:

*Six acres of land at $25 per acre	$ 150
Four hundred and fifty trees at $1 each	450
Twelve years of care at $30 per acre a year	2,160
Interest on amount at 10 per cent for six yrs.	1 656
Total investment	$ 4,416
Total receipts	12,000
	$ 7,584

"The present value of property each one can estimate for himself. Can Mr. Twogood afford to sell that orchard for $5,000 per acre?"

As the market goes, Mr. Twogood does not realize $3 per box for his fruit; but, at half that price, provided the crop holds up to estimate, his returns will be $500 an acre.

If, in the evolution of the orange industry, the time shall come when a grove in full bearing yields only $100 an acre net, the profit ought still to satisfy a man of moderate ambition. With ten acres in trees, yielding a revenue of $1,000 a year, and the hundred and one accessories and economies of country life, a man ought to be able to live and support a family. He may enjoy not only the substantial comforts, but many of the elegancies of life, This is an independence.

*In order to avoid a false impression, I should say that such land is no longer to be had in Riverside at $25 an acre, but is worth, unimproved, ten times that figure.

CHAPTER XI.

CHARACTERISTICS OF THE ORANGE.

Scientists tell us that the orange is a berry. The pulp, the separating membranes and the skin are but a thickening of the pericarp or seed vessel.

In this respect the orange resembles the grape (also a berry) and is totally different from the apple, in which all of the parts of the flower—calyx, corolla, stamens and pistil—are wrought into the fruit. The natural office of the orange, then, is to bear seed.

Before a thousand years of evolution made the orange what we know it today, the tree bore beans—or at least produced its seed in pods clustered together at the end of a stem. If you will peel an orange

and separate it along the membranes into its various segments, you will have before you these seed pods in something like their original form. Doubtless as it first grew, the pulp was much less than we find in our abnormally developed fruit;—there may have been little of the pod except the seeds and the leathery skin which enclosed them. But finally this bunch of seed pods adhered at their bases, and the union extended to the apex, uniting all the segments into a single fruit of spherical form. With this union, the portions of the thick rind which came within the sphere degenerated into the thin membranes which we now find. The development of the pulp into the full, juicy tissues of the perfect fruit is largely the work of man, in carefully selecting the best species, improving them by cultivation, and transmitting the good qualities by the process of budding. Note the fact that the development of these juicy tissues has been at the expense of the seeds and cuticle. The highest type of budded orange is nearly seedless and has a thin rind.

When you find an orange "sport" which shows a tendency to split at the bloom end into a number of pod-like segments, or to show decided creases in the rind along the lines of the segments, as though it had half a notion to divide itself up, remember that the tree which bore this fruit was thinking of its great, great, great grandmother, that passed away a couple of thousand years ago. This "sport," as well as all others, illustrates the natural tendency of all organisms, plant or animal, to revert to an earlier condition. The primitive form of the orange was what scientists term "apocarpous."

The orange tree, compared with many other trees that are adapted to a sub-tropical climate, is of slow growth. It requires about sixteen years for the seedling to attain what might be called its full normal proportions. It then stands about twenty-five feet high,* with a spread of branches of about the same distance, and a circumference of trunk, near the ground, of nearly three feet. The seventy-year old orange tree of the Mission orchard, San Gabriel, which I measured, showed a girth of forty-two inches. The inference is fair that, between the ages of sixteen and seventy, it had increased its circumference of trunk only six inches. As the orange tree attains its maturity, its cylindrical trunk changes to one of eccentric longitudinal corrugations, although, if healthy, the bark still remains smooth.

The wood of the orange tree is close-grained, hard and susceptible to a fine polish. It is of a clear, yellow color, embodying a suggestion of the fruit itself. The top of the tree contains another suggestion of the fruit, for, if allowed to take its natural bent, with little pruning, its contour is almost spherical, like the orange.

The leaves are ovate in form, slightly serrated, and of thick leathery texture. When newly forming they are of a bright yellow hue, but as they mature they change to a dark green, with the upper surface presenting a decided gloss. The tree is an evergreen, and it has numerous seasons of growth during the year, with slight dormant intermissions. I once took careful note of a tree at my place, with the following result: On the first of January there was a little new growth already formed. This made some progress during the month, and hardened up about the middle of February. In April another growth began, and matured in May. About the middle of July the third growing period commenced, and this time the tree made more wood than in both previous growths combined. By the last of August the yellow leaves had all turned to their normal shade, and the stems were hardened. In October there was a slight growth. In December the shoots started again, but this was the same growth I had noted at the beginning of the year. Thus I found four distinct growing periods. It is not unusual for trees to make even five growths in a year under favorable circumstances, while with retarding causes they may make only one or two. The times of starting and maturing may also vary almost a month, according to circumstances

*The size of budded trees varies so much from the standard seedling that I do not attempt to canvass the matter in this article. There are dwarf, semi-dwarf and standard buds, all of which follow their respective habits when set upon a seedling stock, and make trees from five to twenty-five feet in height.

of irrigation, cultivation, temperature, etc. The dormant periods of the orange tree may be generally defined as follows:

The middle of March to the middle of April.

The month of June.

The month of September.

The middle of November to the middle of December.

The orange tree blossoms early in February, and continues in flower until the last of March. The blossom is a pure white, of the most exquisite texture, and its fragrance is so great as to be almost surfeiting. As a typical flower, twined into a wreath to surmount the head of a bride, nothing could be more delicately suggestive of beauty, purity and sweetness. But those who have observed the orange flower only in the conventional bridal wreath have seen but a poor counterfeit presentment of the real blossom.

The fruit sets in February or March and attains its maturity one year thereafter, when the tree blossoms again. At the time of blooming one may see it loaded with its golden fruitage and dazzling with bloom. The contrast of these colors with the dark green of the foliage forms a most enchanting picture. The tree is itself a bride, clothed in satin emerald, crowned with a snowy wreath and decked with precious jewels.

The orange clings to its stem with great tenacity, and it is not unusual to find fruit of a former year's growth still on the tree when a second crop is attaining maturity. The quality deteriorates however if it is allowed to remain long after maturity. In time the juice is absorbed entirely, leaving the pulp a dry, spongy mass.

Concerning the capacity of production, there is great variance. Mr. H. M. Beers has the largest tree in Riverside. It is seventeen years old, and the trunk measures three feet in circumference, or nearly twelve inches in diameter. At the age of nine years it bore about half a dozen oranges; at eleven years it bore two thousand; at thirteen years it bore two thousand two hundred and fifty; at fifteen years it bore four thousand; at seventeen years, which brings it to the present season, it contains, according to estimate, four thousand. Not every orange tree presents such a record as this, however.

The orange tree revels in a high temperature. In fact, very warm weather is essential to the raising of good fruit. It is not sufficient that the warm weather occur in summer, but a high average must be maintained in winter as well, and the extreme should never fall below a certain point. This point may be placed at 23 degrees above zero F.—9 degrees below the freezing temperature. A cold spell that reaches this extreme will destroy young orange trees in nursery and nip the tender growth of older trees. In the latter part of January, 1883, the thermometer reached 17 degrees above zero in many places in Southern California. That was an unprecedentedly cold wave. Oranges were frozen on the trees, and their juices utterly destroyed. The trees themselves were frosted at the extremities of their branches, but suffered no serious check. Younger trees were considerably injured, and nursery stock was frozen to the ground. The lemon trees suffered more than the orange, and many lime orchards were utterly destroyed.

While the full-grown orange tree will survive a good deal of cold weather, and is not destroyed by the extreme above named, it may still be set down as a safe proposition that the less frequently the thermometer goes below the freezing point (32 degrees above zero) the better it is for both tree and fruit.

The orange is long-lived. An instance is on record of a tree in Italy living to the age of four hundred years. But that was with the most careful treatment, through successive generations, with repeated renewals of the soil. As we grow the orange tree in the open air, with a minimum of attention, a century would probably be its full span. But a hundred years is a long time to exist on this earth, and after such a life of usefulness, if there is any better vegetable kingdom elsewhere, the orange tree ought to be allowed to go there.

CHAPTER XII.

BUDDED VARIETIES.

Although there are a hundred or more named oranges, one might count on his fingers all the varieties that are in request for budding. The leading varieties are the Riverside Navel, Mediterranean Sweet, Paper Rind St. Michael and Maltese Blood, all foreign fruits. Some attention was paid a few years ago to the Konah, Wilson's Best, Wolfskill's Best, Baldwin's Favorite, Du Roi, Australian Navel, Acapulco, Nicaraguan and some other varieties, but these no longer hold their own in the struggle for the survival of the fittest. In fact every other orange is giving way to the Riverside Navel, which has come to be universally acknowledged the best. For variety, a small proportion of Mediterranean Sweet, St. Michael and Maltese Blood are planted, and it is likely that other kinds will find their way to a share of popular favor. But it must be a fine orange that wrests the palm from the Riverside Navel. As public opinion was a number of years in coming to this conclusion however, and meanwhile the honors were more or less divided, a large number of other varieties were planted and are coming into bearing. The budded fruit product of the State will be diversified enough to suit all requirements.

For convenience of reference, I append a list of varieties grown in California, and also give a list of varieties grown in Florida, which have not been introduced in this State.

Riverside Navel—also known as *Washington Navel, Umbilical, Bahia, Embigou*).—Medium size, round, skin smooth and of fine texture; nearly seedless; juicy; high flavored; pulp melting; quality the best. The peculiarity which gives this fruit its name and marks it beyond any question is a protuberance in the blossom end which closely resembles the human navel. This is in reality a little kernel, enveloped in the skin, which when examined proves to be an aborted orange. The tree is semi-dwarf, and has a few small thorns. In 1873 the Agricultural Department at Washington imported several orange trees from Bahia, Brazil. One of these was sent to Mrs. L. C. Tibbits, of Riverside, San Bernardino county, this state, who distributed a few buds among some friends. But little attention was paid to the original tree or to its offspring until 1879, when some of the fruits were exhibited. Their beautiful color, peculiar form, and excellent quality attracted immediate attention, and stimulated its propagation. It was named Riverside Navel to distinguish it from the Australian Navel, introduced about the same time. The latter is distinctly ribbed lengthwise, of light color and inferior quality, while the Riverside is smooth, of a golden bronze tint and a fine texture; satin-like skin; its flavor is delicious—something like a combination of the best qualities of the Messina and Florida oranges—and the fruit has the additional advantage of few or no seeds. Since the Riverside Navel made its appearance it has eclipsed all competitors, and has taken first premiums wherever exhibited. Soon after it was brought to public notice, Mr. T. W. Cover, of Riverside, became proprietor of the original stock, and he disseminated buds throughout the orange-growing portion of the State.

Mediterranean Sweet.—Medium to large; oval; pulp and skin of fine texture; flavor delicate, less acid than any other variety of orange grown here; nearly seedless; ripens late. The tree is a semi-dwarf, almost thornless, matures early, and has a tendency to overbear. Fruit should be thinned vigorously to insure a fair growth of wood and development of fruit remaining. Mr. Thos. A. Garey, who introduced this orange, says of it: "About the year 1870 I imported several varieties of orange trees from Messrs. Ellwanger & Barry's nursery at Rochester, New York. I think the importation included all the varieties offered for sale by this firm. One of the trees was labeled *Shaddock*. When the *Shaddock* fruited, the fruit proved to be a first-class orange, instead of the coarse, worthless fruit its name led me to expect. I called it 'Garey's Favorite,' but subsequently

christened it 'Garey's Mediterranean Sweet.' Messrs. Ellwanger & Barry were appealed to, but could not identify the fruit with any known variety." Next to the Washington Navel, the Mediterranean Sweet has attained the greatest popularity of any of the budded kinds.

THIN-SKINNED OR PAPER RIND ST. MICHAEL. — Fruit small, round, thin-skinned, high-flavored and a delicious sub-acid; one of the best budded varieties and destined to increase in popularity; keeps well and therefore a good shipper. A vender once told me they sold on the streets of Los Angeles better than any other variety he could obtain. Trees dwarfish in habit, thorny.

MALTESE BLOOD.—This variety derives its name from the peculiar marking of the pulp, which seems to be streaked and clotted with blood. This queer characteristic varies with fruit from different trees, different ages of trees, and in different stages of ripeness, in some instances being barely traceable and in others the blood-red stain suffusing the entire pulp. The older the tree grows the more marked the fruit. The Maltese Blood is a little under medium size, smooth, round and fine textured; juicy; high-flavored, and the pulp tender and melting. The tree is a semi-dwarf; thornless or only slightly thorny.

KONAH. — A California seedling from seed grown on Konah Island; most of the characteristics of a first-class seedling, the chief advantage being in the uniformity of fruit; thick rind, juicy, large. The tree grows to the full size of a seedling and is thorny.

DU ROI.—Size medium, round, skin firm; quality good, fruit apt to be ribbed somewhat like a musk melon. Trees prolific, vigorous, few thorns. Long grown in Florida and imported from there.

ACAPULCO. — Tree a vigorous, strong grower; rind, thick and rough; pulp, coarse; flavor, good; regular but late bearer.

WILSON'S BEST.—A seedling of the latter class, originally grown by Hon. B. D. Wilson. All the characteristics of a good seedling.

WOLFSKILL'S BEST.—Originated by Mr. Wolfskill, of Los Angeles, and answering the same general description as the above.

BALDWIN'S FAVORITE. — Originated by Mr. E. J. Baldwin, of Los Angeles county. Same as above.

NICARAGUAN. — A seedling from fruit brought from the peninsula by Dr. J. Shaw twenty-five years ago. Fruit very large, thick skinned.

HOMOSASSA.*—Of Florida origin; size of fruit medium, somewhat flattened, very heavy; color bright; skin very smooth, thin, tough and dense; pulp fine, sweet and juicy; flavor full and vinous; membrane covering segments of pulp very thin and small; ripens very early and keeps and carries well; quality best. Tree prolific, vigorous, very thorny.

TANGERINE, MANDARIN, OR KID-GLOVE ORANGE.—This is a dwarf both in tree and fruit, and has been grown for ornament and curiosity more than for any other purpose. I see, however, that its cultivation is extending in Florida to supply a certain dilettante custom, which likes to eat its orange without soiling its gloves. The fruit is very small, saffron-colored, flattened at the ends, and the skin parts readily from the pulp, while the pulp divides readily into sections without the loss of juice. It has a peculiar fragrance and flavor, but altogether amounts to little more than a bon-bon. Its use is only a passing fancy, I think, and a man would hardly be justified in planting a large grove of Tangerines. The tree, or shrub, as it might be termed, is regarded by some botanists as a distinct species, and by others as a marked variety of the sweet orange. It is very ornamental, being distinguished by its small, lanceolate leaves; slender, flexible branches; somewhat formal habit of growth, and the flowers, which are white and smaller than those of the ordinary orange.

PUMALO.—A dwarf tree with peculiar glossy foliage, leaves drawn as if by a puckering string, and a fruit as large as the baby's head. Not good to eat. Grown for ornament only.

BERGAMOT. — Fruit large, rough, flattened; quality fair; leaves large and broadly winged; when bruised give forth

*A few trees of this variety are to be found on Mr. A. S. White's place, Riverside. The fruit is of fair quality.

a delicious aroma not unlike that of bergamot, from which peculiarity the tree derives its name. Grown mostly for ornament and curiosity.

Besides the above, Mr. Garey enumerates the following forty varieties which he imported or propagated:

LARGE ST. MICHAEL.—Thick skinned; inferior.

SMALL ST. MICHAEL.—Doubtful whether it is an established variety, but, if so, entirely distinct from the Paper Rind St. Michael; small, thick skinned; inferior.

MALTESE OVAL.—Not fruited.

LOS ANGELES.—Common Seedling.

CHUCHUPILLAS.—Mexican, not fruited.

BITTER.—Bigarade of Florida.

MYRTLE LEAF.—Ornamental only.

PERNAMBUCO.—Not fruited.

WHITE ORANGE.—Pulp white, inferior.

VARIEGATED ORANGE. — Ornamental only.

EXQUISITE.—Small; no value.

SANDWICH ISLAND.—Small and very sour; no value.

LARGE CHINESE.—Not fruited.

PROLIFIC.—Not fruited.

FORBIDDEN FRUIT.—Not fruited.

EMPEROR MANDARIN.—Dwarf fruit; fair; not equal to Mandarin.

COOLIE MANDARIN.—Tall, standard tree; thorny; fruit, dwarf.

DWARF MANDARIN.—Dwarf tree; fruit identical with that of the standard Coolie Mandarin above.

CANTON MANDARIN.—Not fruited.

THORNY MANDARIN.—Not fruited.

EMPEROR OF CHINA.—Not fruited.

ST. JAGO.—Not fruited.

EGG.—Not fruited.

NUTMEG.—Not fruited.

SEVILLE.—Not fruited.

RIO.—Not fruited.

TENERIFFE.—Not fruited.

PARAMATTA.—Not fruited.

HEONG LEONG.—Not fruited.

SABINA.—Not fruited.

CUMQUAT.—Not fruited.

QUEEN.—Quality fair.

POOR MAN'S ORANGE.—Not fruited.

SELETTO.—Not fruited.

BOUQUET.—Blooms continuously; very ornamental.

TAHITI.—Seedling; same as common Los Angeles fruit.

LORETTO.—Not fruited.

EXCELSIOR.—Fruited; thought to be a fine variety and a possible acquisition to our budded fruits.

FLORIDA SEEDLING.—Same as Los Angeles Seedling.

PORTUGAL.—No value.

The following varieties grown in Florida are held in high esteem there, but have never been cultivated in California, so far as I am informed. For this list I am mainly indebted to Manville's Practical Orange Culture:

EARLY OBLONG.—Synonym, *Thornless Bell*.—Fruit medium size, oblong, thick skin; lacking the sub-acid of other sorts; quality fair. Though its color does not turn much before the other sorts, its juices attain perfection one or two months earlier, when it should be marketed. Tree bears young; prolific; vigorous; not as large as some; leaves elliptical, acute and scattering; branches slender and thornless. Originally imported, but long grown in Florida.

SATSUMA.—For the following description of this tree I am indebted to Mr. A. F. Styles, of Jacksonville. He writes:

"This new Japanese Orange was introduced into Florida several years since, by Mrs. General Vanvalkenburg, of St. Nicholas, and is destined to take high rank among the new varieties. The tree is of dwarf habit of growth, entirely thornless, and very hardy. In the cold 'snap' of December, 1880, the leaves of this tree did not even curl, while all other varieties, with the same exposure, lost all their leaves. It is sure to bear the second year from budding, and it will bear too heavily unless prevented by thinning. It makes a much more vigorous and thrifty tree, if budded on a sweet stock, in preference to the sour, or bitter-sweet.

"Of the fruit, Dr. Davis, in his book on orange culture, says: 'This fruit belongs to the loose-rind species, *Citrus Aurantium Japonicum*, is medium size, flattened, deep orange color, smooth, thin skin, which is sweet, aromatic and easily detached from the pulp. Color of pulp, dark orange; segments part freely; fine grain, tender, juicy, sweet and delicious. There is none of that rank odor which characterizes most other varieties belong-

ing to the same class and species. It is destined to take high rank as a table and dessert fruit.' "

NONPAREIL.—Size above medium, somewhat flattened, color ordinary, grain fine, pulp melting and tender, juice sub-acid and vinous. Quality best. Tree prolific and very thorny. Native seedling.

HIGGINS.—Medium, fair; skin smooth and thin; pulp fine, juicy, sweet and excellent. This variety was awarded twice the first premium at the State fair, for quality.

OLD VINI.—Size above medium; color, dark orange; skin rather rough, medium; pulp rather coarse, juicy, sweet and remarkable for a sprightly aromatic flavor.

TARDIFF. — Large, dark orange; skin smooth and thin; pulp rather tough; grain fine, juicy and sweet; an ordinary orange, but valuble for its late ripening qualities.

ARCADIA.—Size large, color deep, skin smooth, medium; pulp deep rich color, coarse melting, juicy and sub-acid.

SWEET SEVILLE.—Small, color dark; skin thin, pulp very fine, juicy, melting and very sweet and sprightly.

Other varieties named but not requiring special description:

PHILLIP'S BITTER SWEET.

DRUNNETT.

DIXON.

SPRATT'S HARUM.

PARSON BROWN.

EGG.

BIJOU—DANCY'S TANGERINE.

PEERLESS—Synonym, *Rembert's Best.*—Large; round; color, light clear orange; skin smooth, fine and thin; juicy; juice sub-acid; flavor delicious; quality best. Tree prolific, vigorous and very thorny. Native seedling.

MAGNUM BONUM.—Size large to very large; flattened; color light, clear orange; skin smooth and glossy, grain fine, tender and melting; fruit heavy and juicy; juice sweet, rich and vinous; quality best. Tree prolific, vigorous and very thorny. Native seedling.

SOUR.—Large; color dark; grain coarse; inner rind bitter,; juice acid. Retains its perfection throughout the summer, when it is much prized for its refreshing acid juice; used also for making marmalade and conserves. The tree bears young; very prolific; vigorous; makes a desirable and ornamental shade tree. Native wild orange of Florida.

BITTER SWEET.—Medium size; juice sweet and pleasant when separated from the inner bitter rind. Used in summer as a subsitute for the sweet fruit. Tree indistinguishable from the above. Native wild orange of Florida.

Part II.

PRACTICAL ORANGE CULTURE.

CHAPTER I.

PROPAGATION.

When it came to planting my orange orchard, I found the buying of young trees at 75 cents apiece a severe strain upon my resources. To grow my own stock from the seed was not to be thought of, since that would involve a delay of three or four years. Time is money in fruit growing. So I hit upon the plan of buying trees for my own orchard and planting seeds for some other man's orchard; paying tribute myself and taking letters of marque and reprisal against the next generation of orange planters. The idea was by no means original, for I found an old gentleman in Pasadena who had carried out the scheme before me. He had reared his nursery in the open spaces between his rows of orange trees, and he told me that from less than an acre thus devoted he had realized $600. His success as an amateur propagator was marked, for I found in his nursery the finest and healthiest trees in the market. His example, no doubt, had much to do with confirming my purpose to plant seeds.

After reading all the available authorities on propagation, and consulting all of the nurserymen of my acquaintance, I did as most people do who take advice—followed a plan of my own. As my method proved quite successful I venture a description of it. Perhaps it will be of service to some reader in forming a plan of his own better than mine. I do not claim to have originated anything in the matter of propagation, but merely to have studied the delicate requirements of the orange seed and plant, applying thereto the most suitable and, at the same time, the most labor-saving methods which I could devise.

TIME.—I planted in June.

BOXES.—From a fruit jobbing firm I obtained a quantity of boxing material in the "shook." Size of boxes: Eighteen inches square and five inches deep. They were a kind known as "peach boxes," and being of a size out of use I got them for nine cents apiece—about one-half market rates. The making of 160 of these boxes required two days. They were fastened staunchly with four and six penny nails, the lids, of course, not placed. I followed the precaution of leaving cracks of a quarter of an inch between the bottom boards to facilitate drainage.

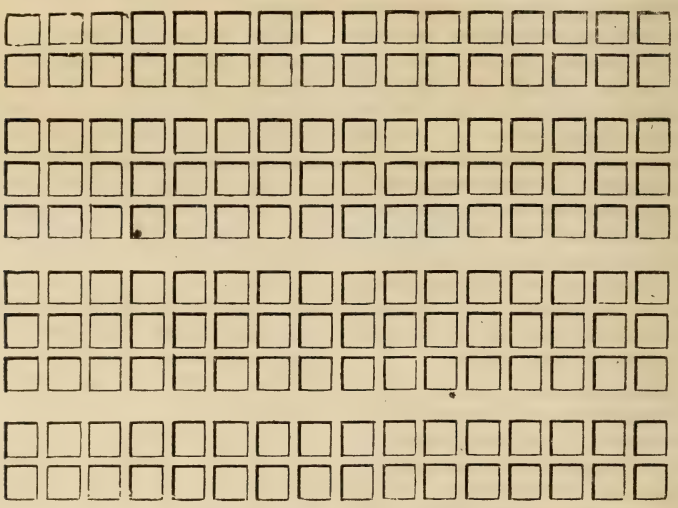
SOIL.—While the boxes were making the Chinaman was engaged hauling and preparing the soil to fill them. In the bottom of a ravine, among the oak trees, I found a sediment deposited by the winter flood, which seemed to be the lighter and finer particles washed from the soil above. It formed a compact, grayish-black mass, which cracked open as the moisture dried out of it, and one could pull it up in cakes. Its weight was only about two-thirds that of average soil. It crumbled readily between the fingers, leaving a powder almost as fine and soft as flour. "This," I said to myself, "is humus, and as near the pure article as Nature ever prepares it." So I had Ah Ngoon haul a quantity of the sediment. I prepared it for use by pulverizing and then passing through a screen, and at the same time adding a third part of sifted sand. This mixture made a warm, mellow, rich soil, free from gravel and all other obstructions, and one also which would not pack under the repeated application of water. It proved to be remarkably free from wild seeds, thus obviating a deal of laborious weeding. In fact it was the very *ne plus ultra* of a propagating soil, according to my notion. I would not know how to improve it in a single particular were I planting again.

FILLING THE BOXES.—From the pile of prepared soil we filled each box about two-thirds full, striking off the top to a

level surface. For a striker I used a little board, notched, as shown in the accompanying diagram, to allow the lower edge to play freely inside the box an inch and a half below the top edge.

THE STRIKER.

PLACING THE BOXES. — The ground where the propagating boxes were to be located had previously been graded to a level. As each box was in turn filled and leveled, it was placed in position where it was to remain through the season. Narrow strips of lumber were laid on the ground for the boxes to rest upon, thus admitting a free circulation of air beneath for warmth and drainage. There were four tiers of boxes, the two outside containing two rows each; the inner, three each. This made ten rows, with sixteen boxes to the row—altogether 160 boxes. Between the tiers alley-ways, eighteen inches wide, gave access to every part of the bed. No alleys were left around the outside. From any alley I could reach over the first row of boxes and work in the second row without inconvenience.



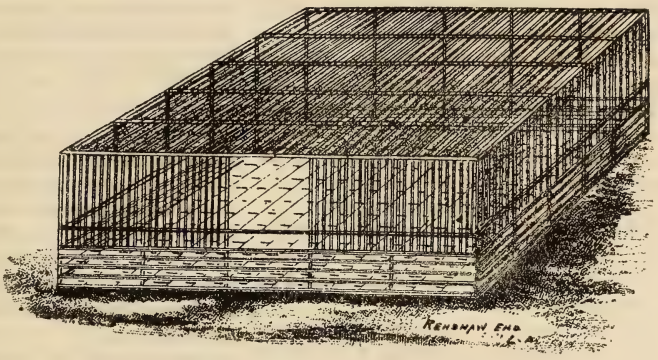
ARRANGEMENT OF THE BOXES.

SEEDS.—For seed, in my first planting, I obtained some well-matured seedling fruit. A quantity of cullings — thorned and partially rotted fruit—thrown out by a packing house, served the purpose, and my only expense was the hauling. I have since used seeds from imported Tahiti oranges. The foreign seeds are plumper and more fertile. These I ordered from a San Francisco importing house, and the expense, delivered, was $7 per barrel of rotted oranges. A barrel yielded about eight thousand seeds. In my first planting, however, the native seeds did fairly.

EXTRACTING THE SEEDS.—In using fruit that was sound, or nearly so, I made a latitudinal cut about the orange, taking care that the knife penetrated only a part of the way through the pulp. The halves were then torn apart, and the seeds forced out by pressing down upon the pulp with the ball of the thumb. In handling thoroughly rotted fruit I used a sieve with quarter-inch mesh. In this the pulp was thoroughly macerated and washed with water. The finer particles passed through the sieve, and the skins and coarser parts were picked out, leaving the seeds separated and clean. The seeds should not be allowed to dry before planting. I kept mine in a bucket of water until used. I tried, to a certain extent, the Mediterra-

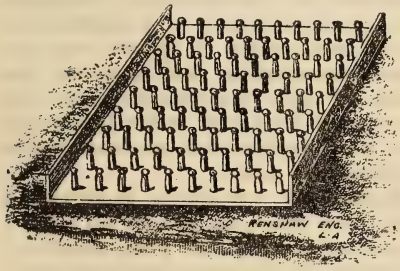
nean plan of throwing out the seeds that floated in the water, but it quickly became apparent that this was no test for them, the difference in specific gravity being so slight and variable that half the seeds that floated in the evening would be at the bottom in the morning, and *vice versa*. With native seeds the only test that seems worthy of mention is that of size and plumpness, the fuller being the more fertile. With Tahiti seeds, however, the test may be applied with advantage. Put the seeds in water and reject all that float.

PREPARATORY TO PLANTIG.–As soon as a row of boxes was in place, I sprinkled them lightly to give consistency to the soil for convenience of working. Then I went over them with an implement which, for lack of a better name, I call—



THE PROPAGATING HOUSE.

A STAMPER.—A board nineteen inches square, perforated with auger holes an inch and a half apart, and a round-headed pin (I used old-fashioned clothes-pins) inserted in each hole. There were one hundred and fourteen pins, and these, when



THE STAMPER.

the stamper was applied with considerable pressure upon the plastic surface of the soil in the box, left one hundred and fourteen little indentations. Accuracy in the matter of stamping was promoted by a couple of cleats on opposite sides of the stamper, which, fitting snugly outside the box, guided the appliance as it was lowered to place.

INSERTING THE SEEDS.—The stamping completed, it was next in order to drop a seed—*one only*— in each indentation.

COVERING.—As soon as a box had received its complement of seeds, a layer of half an inch of the same prepared soil was added, thus covering the seeds securely and evenly. The final leveling of the surface was performed by a striker exactly like the one first named only not notched so deeply. The soil as finally leveled was an inch below the rim of the box. The final operation was

WETTING—Which was done as soon as a row of boxes had been planted and leveled. With a fine rose sprinkler attached to the hose, I sprayed the boxes until the soil was well moistened. My bed of one hundred and sixty boxes contained a little more than eighteen thousand seeds.

A PROPAGATING HOUSE.—This was already occupied before it was built. I had "anticipated," as the novelists say; but this was done designedly, because I thought it would be easier to build the house over the boxes after they had been planted and arranged than to move the boxes, after planting, into the house. My propagating house was a very simple affair, though entirely different from the muslin covering usually prescribed in such cases. I built, in fact, a structure quite similar to a chicken coop, roofed over with lath. The house was twenty feet by thirty in ground dimensions and six feet

high. This was a little larger than my bed of one hundred and sixty boxes required, but I provided for extra "elbow room." The framework of the house was of two by three redwood stuff, posts six feet apart, and a row of posts standing longitudinally through the middle (planted in the central alley) to sustain the roof. All of the lath work for sides and roof was built in detached panels, the roof panels being merely laid on a framework provided for that purpose, and the side panels tacked on so that they could all be removed at will. In the winter when my young trees needed all the sunshine they could get, these panels were taken off the south and east sides and the top. Thus I got a good exposure without moving the boxes. Around the sides of the house for the height of two feet there was a base of three inch strips with open spaces of an inch between. These were deisgned to remain permanently as a guard against depredating animals. The movable side panels were fitted above this base. The general appearance of the house is represented in the foregoing cut.

Objects and Advantages.—The main object of this lath structure built over the propagating boxes was to supply a semi-shade for the young plants, as they could not endure the full glare of the summer sun. The particular advantages which I claim for my propagating house over a muslin covering are its free admission of light and air, its easy accessibility and the excellent protection which it offers from animals. When cloth is used for a shade there is much trouble in removing the covering when one wishes to get at the plants. Then, too, the boxes cannot be grouped so compactly, but need to be strung out in long tiers. But the old way of propagating does not contemplate boxes at all, the seeds being sown broadcast in a bed and afterwards transplanted. The advantages which I gain from the boxes are these:

1. The seeds being distributed regularly and not too close together, each plant has abundance of room from the outset.

2. No transplanting is necessary until the trees are a year old, when they can be placed in the nursery rows at once.

3. In transplanting, the boxes may be hauled to the nursery and the trees left undisturbed until each, in turn, is set into the ground.

4. By the use of the Widney transplanter, or some similar device, a ball of earth may be taken up with each tree, thus avoiding an exposure of the roots to sun and air and greatly augmenting the chances of life and thrift in the young tree.

Expense.—The items of expense of my seed and planting (native seeds) and propagating house were as follows:

One hundred and sixty boxes at nine cents	$14 40
Making same, two days at $2.50	5 00
Hauling and preparing soil	3 00
Planting seeds	10 00
Propagating house	35 00
Total	$67 40

The items for propagating house and boxes need not be considered an irremediable expense, as the boxes will serve for another season's propagation, if desired, and the house will do for many seasons, or it may be readily converted to other uses. The panels being all detached are immediately serviceable for a fence or chicken coop.

Convenient to Water.—My propagating house was located close to a hydrant, and by attaching a hose and using a rose nozzle I could irrigate the entire bed in twenty minutes. I took care at first not to allow the surface of the soil to become dry. It was necessary to irrigate every alternate day.

Mulching.—The retention of moisture was greatly promoted by a mulching of wheat chaff, which I spread over the boxes immediately after planting the seeds. I took care that my chaff was thoroughly freed from wheat before putting it on, as there was no room in the boxes to raise grain.

Danger in too Much Moisture.—The boxes must not be kept too wet. I lost some young plants from what nursey-men call "damping off,"—the roots rotting and the stems and leaves turning yellow and withering. As stated, I sprinkled my bed every alternate day to begin with. This plan was followed well through the summer, when the irrigations were reduced to two a week, then one a week, and finally, when the winter rains

set in, discontinued altogether. The loss of plants from damping off was inconsiderable, and due, I am led to believe, more to imperfect drainage in some of the boxes than to an excess of water applied. In irrigating, however, it should be borne in mind that the earth needs simply a good moistening, not a soaking.

GERMINATION OF THE SEEDS.—Six weeks after planting, the greenish-yellow orange shoots began to appear in the boxes. They came along quite irregularly, but in three months the quota was well filled. Some seeds, lacking vitality, sent up weak and spindling shoots; others, from an excess of germinative force produced twins. Some of the former died, and the latter I thinned out to one stalk apiece, putting the extra plants in vacant places.

WEEDING.—Two thorough weedings, with a little attention in snipping out irregular interlopers, sufficed to keep the bed clean the year through. Herein, as stated, I experienced the benefits of a clean soil. Had I used manure instead of natural mold there would have been far more of this business on my hands. A covering of green moss, which formed on the surface of the boxes toward the latter part of summer, gave me some apprehension, and I broke it up once by stirring the soil between the young plants and omitting an irrigation or two; but it came back during the winter, and I allowed it to remain as no harm appeared to result. In the next planting I obviated this difficulty by making the covering of clean sand instead of the prepared soil.

ENEMIES TO THE YOUNG PLANTS.—I lost a number of plants through the depredations of a pair of linnets, which seemed to take great delight in nipping off the tender new growth. I succeeded finally in scaring the little fiends away. The next trouble came from a family of toads that attempted to squat on my claim. These I carried out by the hind legs. A rabbit got into the inclosure on one occasion and mowed down some of the trees. He did not come again. These, with the damping off, were the only fatalities which overtook my young nursery. But under different circumstances new enemies might appear. It is advisable for one to keep a sharp lookout continually, for, in the words of the hymn, "Ten thousand foes arise."

PROTECTION FROM COLD.—During two or three cold spells which occurred in the winter, I kept the young trees covered with gunny sacks and such other old cloths as were available.

THE OUTCOME.—In June, one year after planting the seeds, I was ready to transfer my stock to the nursery rows. From the 18,000 seeds planted there were 10,000 trees, ranging in height from four to twelve inches. Had I chosen to sell them they would have brought me two and one-half cents apiece, or an aggregate of $250, which would have paid fairly for the investment and labor.

CHAPTER II.

PLANTING THE NURSERY.

LOCATION.—Much may be said about locating a nursery, but all the rules prescribed can not obviate the necessity for a study of the special requirements in each case. To a certain extent, every nursery is a law unto itself. There are peculiarities of soil, of situation, of surroundings, of climate, which must be considered jointly and severally. So far as lies in human prevision, every obstacle ought to be anticipated and forestalled. A failure to do this in some apparently trivial particular may entail endless unnecessary labor, vexations, losses, and perhaps ultimate discouragement and disaster. Some good man has said there are no *little* sins; in nursery planting there are no *little* mistakes.

General Requirements. — The requirements of a nursery may be generally stated as follows:

1. Accessibility and convenience to market.
2. A rich, mellow soil.
3. A warm situation.
4. Abundance of water.
5. *Convenient* irrigation.

Soil.—Provided the elements of strength are there, the looser and more friable the soil the better the trees will flourish. Any ground that bakes hard should be avoided. Do not plant your nursery on adobe land. Trees cannot flourish with their roots in vulcanized casings. But, in avoiding the extreme of stiff soils, do not run to the other extreme of too sandy ground. A certain proportion of humus and some tenacity in the soil are necessary to retain moisture and to give the trees a good footing. Then, too, bear in mind that, by and by, when it comes to taking up, the trees, you may want to ball the roots. This you cannot do unless the earth has a good deal of coherence. Balling is not a *sine qua non*, as will be explained subsequently, and I would not advise the abandonment of a generally good location for the single objection that the ground is too loose to ball. The chocolate-colored clayey sands or sandy clays, which abound in our foothills, are the happy medium of a nursery soil, being stiff enough to ball, but not inclined to bake, if fairly cultivated.

Well Drained.—It is necessary that the ground for a nursery should be well drained; *i. e.*, there should be no standing water close to the surface, rendering the soil cold and sodden.

Topography.—Opinions are divided as to the comparative advantages of a level piece of ground or one with a gentle slope to the southward. The sloping land has the warmer exposure and is likely to be better drained. The level land is more convenient for irrigation. But whether the ground be flat or sloping, before the trees are planted it should be graded to as near a perfect plane as possible. Leave no basins or hummocks anywhere; they won't do, as you will find at your cost if you attempt to run water over them, through them or around them. Your graded plane may have a uniform pitch of a foot in one hundred in the direction you intend to irrigate; half a foot would be better in most localities. If the nursery site is on a hillside sloping to the south, make the pitch for the purposes of irrigation east or west. You cannot, with advantage, run water down any considerable slope.

Preparation of the Soil. — The ground having been graded, it should be double-plowed and harrowed. This, if it be the kind here recommended, will reduce the soil to the requisite tilth. If not perfectly pulverized with this treatment, it should be reduced still further with harrow or clod-crusher; but the better plan would be to pick out some other locality for your nursery.

Arrangement of the Nursery. — When a nursery is planted on level ground, it is considered advisable to run the rows north and south, in order that the sun may have the greatest play upon the ground. On a southern slope the rows should be east and west, the matter of irrigation there assuming paramount importance. Located on more broken or irregular ground—say a series of knolls or hillsides—the contour system is adopted, running the rows in curves and reflexes—keeping always at a certain level practicable for leading water along the rows. The greatest objection to this system is that it makes cultivation difficult, sometimes precluding the use of horse power altogether.

Room for Access and Working.— If your nursery is a large one, divide it into tablones, with drive-ways between and the rows not more than one hundred and fifty feet long. This gives convenient access to all parts of the nursery, and you do not have to carry the trees a great distance in loading them into a wagon. It also allows space for turning, in cultivation.

Laying off the Ground.—The established way of planting nursery is in square or parallelogram form, with rows four feet apart and trees a foot apart in the rows. This gives 10,800 trees to the acre. The operation of laying off is very simple. The outlines of the nursery or of the tablone being established, stick stakes along

two opposite ends to define the rows. Then stretch a rope or chain across the ground from stake to stake, and along this line plant the trees a foot apart.

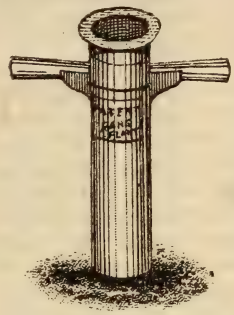
Various labor-saving methods are in vogue for spacing off the ground along the line, but none more ingenious and practical than that recommended by Mr. Thomas A. Garey in his pioneer work on California orange culture. He says: "For marking the spaces in the row, use a tool made similar to a hand-roller with triangular pieces a few inches long fastened lengthwise and a foot apart. Four feet in circumference, or a small fraction more than fifteen and one-fourth inches in diameter, is a convenient size for the roller. To use this tool, take hold of the handles, place the roller on the tightly-stretched line, and push it forward or draw it after you along the line; the pieces on the roller will mark crosswise of the line at regular distances of a foot. If any other distance be desired, it can be regulated by the diameter of the roller and the distance between the strips. Remove the line to the next proposed row. This leaves a mark lengthwise crossed at regular distances, ready to receive the plants."

This implement is available in planting large nurseries. For a small nursery, of course, the labor of making the roller would be greater than the marking off by some more clumsy method.

PLANTING.—The accepted time for planting a nursery is in April and May, when damp, cool weather is apt to prevail. But, with proper safeguards, planting may be done in almost any month of the year when there is no danger from frost or very excessive heat. If your trees are propagated as mine were, in boxes, transplanting is simple and sure. The workman carries a box with him along the line and transfers each tree, with its ball of earth inclosing the roots, to a place in the row.

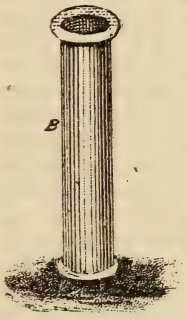
The implement used for this is the invention of Judge R. M. Widney, of Los Angeles, and known as the Widney transplanter. Not only is it a great labor-saving device, but its use amounts almost to a guaranty of the life of the plant. With it I set a nursery of 4000 trees in the months of June and July. Very hot weather followed, and the trees were not shaded, yet my loss did not exceed one per cent.

THE WIDNEY TRANSPLANTER.—The accompanying cut represents the transplanter complete. The cylinder *A* is first used to cut a hole, *D*, in the ground where you wish to set the plant. Next the transplanter is set down over the plant, so that the stem and leaves run up within the inside cylinder *B*. The outside cylinder is then passed down into the ground, giving it a slight rotary motion, until you have cut to the depth desired, generally two or four inches. In pressing down on the handles care must be taken to keep the hands off the inside cylinder *B*, which must be left to move freely. The rotary motion gives a sharp, drawing cut.



TRANSPLANTER COMPLETE.

After cutting down around the plant to the depth required, lift the transplanter out of the ground. It will bring up the plant with a solid plug of earth, *C*, inside the cylinder. Now put the transplanter containing the plant into the hole in the ground *D*, first cut. Set it down to the bottom of the hole, so that the bottom of the plug of earth rests on the bottom of the hole; place the two thumbs on top of the inside cylinder, retaining the hold on the handles with the fingers, and close the hand, thus drawing *up* the outside cylinder, while the inside cylinder thus holds the plug of dirt in the hole. The plug of dirt is thus forced out of the transplanter as the wad is forced out of a pop-gun. When this is done, the plant, with a solid plug of earth, *C*, will be left in a hole sur-



INSIDE CYLINDER.

rounded by unmoved dirt. Tamp the earth a little to settle it about the plug, and the transplanting is complete. After a few experiments the work can be done with great rapidity.

PLANT RAISED WITH PLUG OF EARTH.

Concerning the planter Judge Widney says: "Three years ago I commenced to set out some 200 acres of eucalyptus trees. I raised the plants and put them in boxes 20x24, setting them two inches apart —the usual plan. To set them out in the field and not irrigate, and do the work rapidly, was the question. The result was this transplanter. With it one man will take the boxes of plants and set out 600 to 1000 trees per day, nine feet apart. I set out over 100,000 plants, and not one plant in 100 died from transplanting."

HOLE CUT BY TRANSPLANTER.

Irrigation.—As soon as planted the trees should be irrigated. This may be best accomplished by making a slight trench along each side of the row and a few inches therefrom, throwing the dirt away from the trees. Then lead the water along, and after it has thoroughly soaked away use a hoe to draw the displaced earth back. The dry soil being left on top acts as a mulch to prevent evaporation. Under no circumstances should the soil remain unstirred after an irrigation, as it will bake and dry out, leaving the trees in a worse condition than if they they had been given no water at all. If the weather be warm and dry at the time of planting your nursery, an irrigation each week is not too much to begin with. The soil should not be allowed to dry within half an inch of the surface. Later, as the trees become well rooted, an irrigation each fortnight, and then one each month, will suffice. The second season the cultivation may be done by horse-power.

After Care.—Directly after planting equip yourself with knife or scissors and trim up the little trees. Some of them will have two or three stems, and some will be throwing an undue proportion of their vitality into some favored limb. Trim them to a single stem and start them up in the way they should go. Afterwards replace all trees that die, so as to keep your rows full and regular. When grown to the height of two or three feet, your trees, or a part of them, may require staking. If so, don't neglect this part of the work. You may think that the stalk will be cut down after a while, in budding, and it doesn't make much difference whether it grows straight or not. But it does. The more symmetrical you keep your nursery, the more pride you will take in it, the better you will do your work, and it will thrive proportionately.

Free from Insects.—Watch your nursery with eagle eye that none of the pestiferous scale insects obtain lodgment there. If once thoroughly inoculated with red or white scale, it is all over with your project; nobody would buy the trees afterward, even though you succeeded in clearing out the pests. It is a good plan to wash the trees once or twice every year with a decoction of whale oil soap, as a measure of prevention.

Free from Weeds.—I would enjoin the most thorough cultivation of the nursery, summer and winter, and keeping it entirely free from weeds. But the painstaking nurseryman will do this without special admonition.

Pruning.—When the trees have been in nursery one year, they should be pruned slightly. Be careful not to carry the pruning to excess, and especially avoid making long willowy switches with a mere tuft of leaves a-top. Rather follow the plan of keeping the small tree symmetrical and well proportioned, exactly as you would a large one. Dispense with the lower branches gradually, and the trunk will grow up stocky and strong enough to support itself without staking. When trees are budded at the end of the first year in nursery, little pruning is required; simply enough on one side to make room for the bud; and, after that starts, the entire top is cut away.

CHAPTER III.

BUDDING.

The general theory of extending and perpetuating varieties of fruits by budding is too well understood to require discussion here. While it may be said that the principle has found acceptance throughout the domain of horticulture, with the orange it has remained a mooted question longer than with any other fruit. But here also science is gradually and surely gaining the day. It has been urged against budding the orange that the operation induces precocity, thereby dwarfing the tree, curtailing its productive capacity and shortening its life. That budding induces precocity there is no question. While a seedling tree can not be relied upon to come into bearing until eight years old, a budded tree will bear at five (*i. e.*, the stock being five, the budded growth three). Whether budding dwarfs the tree or not depends entirely upon the habit of the tree from which the bud comes. I have seen full-sized standard trees from buds of the Konah, Wolfskill's Best and Cuban. The Washington Navel, St. Michael, Mediterranean Sweet and Malta Blood make under-sized trees. But by reason of their lesser size a greater number may be set to the acre, and thus, in full bearing, the yield may equal that of standard trees. But the quality waived entirely;—allowing a smaller yield from budded trees—the difference in quality must determine the matter in their favor. In the scales of value a box of uniform Navels will outweigh three boxes of hit-and-miss seedlings. It must be remembered that there is no exact perpetuation of excellence by the seed. A seedling is a seedling, whether the seed be brought from Cuba, Australia or the Mediterranean country. The tree from foreign seed, being grown to maturity in our soil, generally partakes of the characteristics of native stock;—producing a fruit with thick rind, and averaging with the rest in size and flavor. There is, in fact, no likelihood that *any* seedling will improve on these varieties already originated here, and which have been given the distinction of a name, such as Wilson's and Wolfskill's Best, while there are many chances for it to drop far below mediocrity. With budded fruit the case is quite different. Uniformity of excellence is obtained in it. The evil results of the precocity alluded to may be obviated by rigorously thinning the fruit as the tree comes into bearing. In our climate, the tendency of all trees is to overbear at first; and if this is not curbed, their health and productiveness may be seriously impaired. Budded orange trees do not stand alone in this matter, though they may present an extreme case. The fact remains that, if a man buds his trees and devotes to them some extra attention, he may hasten his returns three years and enhance the value of his fruit. Budding is in line with all other advanced scientific methods. What labor-saving machinery is to manual labor, and thoroughbred live stock to native breeds, the budded orange tree is to the seedling. Do not be behind the times. Bud your trees. Having determined this matter to *my* satisfaction, at least, I come to the *modus operandi* of budding. I am indebted to Mr. J. M. Warner, a budder of long experience, for many practical suggestions contained herein.

TIME.—Buds are inserted in the fall—October and November—and in the spring and early summer—March to the last of June, the latter being much the more popular season. The exact time for budding depends indirectly upon the weather and directly upon the condition of the stock to be budded. Buds inserted in the fall come under the designation of "dormant" as they do not start until the following spring. Then, of course, they begin early if at all, and therein lies the only advantage of fall budding. On the other hand, there is great danger that the buds may be killed by severe cold during the winter. Midsummer budding, although feasible, is condemned by the best authorities. The lateness of starting makes a short season's growth, and the wood being prematurely hardened by cold weather, the tree is stunted. The earlier in the spring that budding can be done in conformity with right principles, the better.

Condition of the Stock.—When the bark slips readily upon the stock, as it slipped on the willows in our whistle-making days, you may be sure it is in condition to be budded. Theoretically stated, the tree is then full of sap and in the active, growing condition requisite for infusing life into the extraneous bud inserted in the bark. Experts may venture to anticipate this condition a little and bud trees when they are obliged to raise the bark with a knife, but they do it at the risk of losing their labor. A quick growth of the tree immmediately after each budding is done will alone render the operation successful. Experienced budders claim that a larger percentage of buds grow of those inserted in the new of the moon than in the old.

Age of Stocks.—Trees planted in nursery in the spring are sometimes budded the following spring. But the majority of nurserymen do not bud their trees until the end of the second year in nursery. The stocks then shoot the buds more uniformly and vigorously than at the earlier age. Budding may be done from this time forward until the tree is fully grown, but the difficulty of starting increases with age. Ordinarily there is no reason for delaying the operation later than the end of the second year in nursery.

Implements Required.—The outfit required for budding comprises a pair of pruning shears of the ordinary pattern; a budding knife, a whetstone and strap, a brush and some tying twine.

The budding knife has a prolongation of the handle, being a bone spatula, like the end of a paper cutter. This attachment is of service in lifting the bark without lacerating it after the incision has been made. The whetstone, used with either oil or water, should be fine, and small enough to carry in the pocket. For putting the finishing edge on the knife use a razor-strop or a strop improvised from a piece of leather fastened to a stick and oiled. The pruning shears or pocket-knife should be employed in the heavy work, such as cutting branches for buds, pruning, etc. The budding knife is then used only for cutting out the buds and incising the tree, and its keenness is not unduly impaired. It is best to bud the trees close to the ground, for the reason that the point of juncture of bud and stock becomes less prominent and unsightly, and, in transplanting, may be covered up entirely. Any sort of brush that is convenient will serve for dusting off the body of the tree, so that the knife shall not come in contact with grit.

The buds should be inserted with a view to avoiding accidents in irrigating and cultivating. If the rows run north and south insert the bud on the south side of the stock, so that it shall not grow out into the open space and thus be subject to accident. The prevaling winds should also be considered. As the tendency of the sprout is to grow out from the stock, if the winds can be brought into service to force it back upon the stock and into an upright position, so much the better.

Twine.—A soft, loosely-twisted twine, from ten to fourteen ply, and known as "budding twine," is in universal use among budders. The size is varied, according to the size of stocks. A convenient way of preparing the twine for use is to reel it upon a board the required length for the pieces, and then cut it at both ends of the board. Count the pieces, and when done with them you will know how many buds you have inserted. Sling the strings in a loop of twine to your person, and you have them ready to draw upon as required.

Choosing Buds.—The best buds to insert are those which appear large and plump, as though just ready to start. They are found upon the latest new growth that has rounded and hardened. The light green, new growth, known as "three cornered," should be avoided, the buds being immature and lacking in vitality. Likewise buds on old limbs (*i. e.*, of a former year's growth,) are not desirable, as they are slow to start. Buds cut from very old and hard wood have been known to lie dormant four years before starting to grow. Upon the section of limb which you select all of the buds may not be desirable, and you should use only the best, rejecting the others. If thorny varieties are used discard those with the largest thorns.

Preparing the Buds.—Having selected the limbs from which you wish to take your buds, cut them into lengths of six or

eight inches, convenient for handling. At the same time cut off the leaves, severing the stem close to the buds. If the leaves are allowed to remain they draw the sap from the stock, weakening the buds. The points of thorns may be clipped to avoid annoyance in handling. If the buds are to be kept any time or shipped, the twigs should be packed in some damp material. The green moss which forms on the surface of ponds or reservoirs exposed to the sun furnishes an excellent wrapping when dried. This should be dampened only enough to keep the stems from drying out, and they may be thus kept a fortnight or more without damage. While budding keep the principal part of your stock covered with a damp cloth, having only a stick or two in hand at a time.

Cutting the Buds.—Hold the stick in the left hand, top toward your body; fore-finger sustaining the stick below the bud, and thumb far enough above the bud to be out of danger from the knife. Commencing about a half inch below the bud, make a slanting cut into the twig, raising the bark and a thin shaving of wood beneath it. Draw the knife forward with a straight cut underneath the bud, and when this has been severed, with the bark and wood adhering, bring the edge to the surface with a rounding motion.

The slip thus taken is about an inch long: the part below the bud a half inch, the bud and leaf stem a quarter, and the part above the bud a quarter. It is necessary to take only a very little wood from the twig in serving the bud. I have known pains-taking nurserymen, when operating on young stock, to hollow out the under side of the bud longitudinally, so as to make it conform more closely to the body of the tree to which it was applied. The knife used for taking off buds should have a keen edge.

Cutting the Stocks and Inserting the Buds.—At a point not more than six inches from the ground select a smooth place on the stock and make a short perpendicular incision. This is called the longitudinal cut. The knife simply penetrates the bark. The cut should not be longer than the bud (one inch), and if the bark is free it may be somewhat less, as the lower end of the bud-base can pass under the bark when shoved down, making it more secure and requiring less tying. At the top end of the longitudinal cut make a transverse cut long enough to admit the bud. In making the transverse cut incline the edge of the knife downward, and then, as the bark is penetrated, spread the gash by twisting the knife upward and carrying the knife outward from the tree. In so doing be careful not to tear the bark. This completes the incision. Next pass the lower prong of the bud-base in at the place where the two cuts cross, and, with the thumb of the right hand, press the bud down gently into the opening. Instead of using the thumb, which might in some instances bruise the bud, some budders insert the point of the budding knife in the bud-base, just above the bud, and press down with that. While the bud is being shoved into position the thumb and fore-finger of the left hand should be pressed against the bark on each side of the longitudinal cut to assist in guiding the bud and to prevent a rupture of the bark. When the top of the bud-base is even with the transverse cut it is in proper position. The base is then nearly or quite inclosed in the bark, and the bud with its leaf-stem and thorn (if it have a thorn) protrudes just below the point where the cuts cross.

Tying.—One of the pieces of twine already prepared is then passed about the tree, making usually three wraps above the bud and two below, the tying being done so that there is one wrap less on the side opposite the bud. The twine should be drawn so tight that it can not be easily slipped, and should pass close to the eye of the bud above and below. The bud first adheres at the upper extremity, and especial care should be taken to have it well wrapped there.

Indications.—In between two and six weeks after the insertion of the buds, if they adhere to the stock, the leaf stem next the bud will begin to loosen and

drop off. On the contrary, if it shrivels and clings to the bud, the indication is that the bud is dead.

Cutting the Stocks.—As soon as one is satisfied that the buds have adhered he should cut off the stocks from four to eight inches above the bud, the larger the tree the higher up. An irrigation and cultivation immediately after this will have a good effect in starting the bud. Within a month after cutting away the stocks, the strings should also be cut and removed, especially the wraps above the bud.

Rebudding.—Trees that fail to start the bud should be rebudded as soon as possible. If the first work has been done early, there will be time to rebud the skips the same season.

Sprouts.—The common practice is to remove all sprouts that put out from the stock in order that its whole vitality may be thrown into the bud. Some think the single growth of the bud is insufficient to keep the stock in a healthy condition, and for the first few months leave several sprouts, keeping them subordinate to the bud. If any sprouts be left they should be on the opposite side to the bud in order that they may not interfere with its upward growth. They should be occasionally nipped off; and, finally, when the main shoot gets fair proportions, the interlopers may be dispensed with altogether.

Pruning.—If the growing bud-sprout shows too great a tendency to branch, it is advisable to thumb-prune it somewhat or to shorten in the lower branches. The new growth should be trained to sturdy proportions and an upright growth. If staking be necessary, stake it, but make it grow upright without this if possible.

Cutting away the Stubs.—When the wood of the budded growth shall have hardened up somewhat, cut away the stub of the stock close to the point of juncture. Pare the stock smooth, and cover with paint, shellac, or wax, to prevent the wood from drying out and cracking.

Influence of Stock on Bud.—While, in theory, the budding of a tree amounts to an absolute change in the fruit, substituting the variety budded for that of the native stock, practice demonstrates that the stock still exercises an influence through the budded growth. This influence varies with different fruits, in some being quite imperceptible, in others so pronounced as to render budding nugatory. For example, the lemon may be budded upon orange stock with the best results; and, in fact, it has come to be a universal custom to choose orange stock for this purpose by reason of its greater hardiness. But with the orange budded upon lemon stock the case is different; deterioration of fruit is sure to follow. At one time there was quite a furor for budding choice varieties of orange upon the stock of Chinese lemon. The vigor of the stock caused a marvelous growth in the orange buds, and the experimenters were in high feather until their trees came into bearing. Then it was found that the fruit was large, coarse, pulpy and insipid, being neither orange, lemon, nor a palatable hybrid.

Standard Lowered by Repeated Budding.—It is safe to assume, then, that all stocks exercise *some* influence on their budded fruit, and though in a single instance we might be unable to perceive it, the probability is that several generations of buds, each taken from the last preceding and each inserted in the same stock, would finally bring a fruit much modified and approaching in character that of the seedling operated upon. Thus it is that the standard of certain varieties has been lowered by successive buddings. A, impressed by the excellence of the Mediterranean Sweet, obtained buds from the stock first introduced and inserted them in some of his poorest trees. B obtained buds from A, and inserted them in lemon stock. Then C got them from B and D from C, and so the retrograde movement continued until the product of the last Mediterranean Sweet buds was found to be very inferior. Other varieties beside the Mediterranean Sweet have suffered in this way. The Australian Navel, which falls short of its twin sister, the Riverside Navel, is one of the victims.

Original Buds.—It is advisable then, in budding to a choice variety, to go back to the original stock if possible; otherwise to get buds only one degree removed from the original, and those grown on

non-deteriorating trees. Too much care cannot be exercised in this matter if our standards are to be maintained.

GRAFTING.—The cheapness and greater convenience of budding the orange has rendered grafting obselete. A nurseryman of my acquaintance claims that he can bring the orange to fruit much earlier by grafting than by budding, and has experiments under way to prove his assertion. It is possible that the next step in scientific culture may be in this direction, but I deem it hardly probably. In Florida grafting is a popular method of converting the wild (Bigarade) orange to the commercial fruit. Grafting would be of equal advantage with us in treating old trees, in which it is difficult to make buds live.

CARE OF THE BUDDED STOCK.—The care of budded nursery stook, as regards cultivation, irrigation, staking up, pruning and keeping free from insects, should be as painstaking as that enjoined for young seedlings. When the buds are one year old and the stocks two or three (according to the age at budding), the trees are sufficiently advanced to be taken up and transferred to the orchard. Of this transplanting I shall say something in a subsequent chapter.

CHAPTER IV.

A WORD TO THE WISE.

The man who contemplates planting an orange orchard — especially the man of limited means—ought to stop and think twice. He should consider that it is a great undertaking to raise orange trees; and he should also bear in mind that, during the long period in which they are attaining maturity, his family and himself must have a living. If, after weighing the matter carefully, he comes to the conclusion that he is possessed of the requisite courage, perseverence, energy and thrift for the undertaking, with a natural taste for it which will make his labors and trials endurable; and if he thinks he can see his way clear to keep the pot boiling through several non-producing years, why, let him go ahead, and God speed him! He is embarking in a good enterprise, and one that will surely bring its reward if intelligently carried through.

Too many men undertake the growing of an orange grove without fully comprehending the magnitude of the task. When it is past the time for them to retire without sacrifice, they find out that it was a fancy, not a well-settled purpose, that first possessed them, and the labors involved are too onerous to be borne; or, their means having run out, they get into debt, mortgage the farm, and then, perhaps, as the trees are just about to bear, the result of all their labors and sacrifices is swept away! I do not propose to read anybody a lecture. Neither do I wish to discourage any who have reasonable chances of success from entering the field of orange growing; but, if a candid word of mine may set some over-sanguine man to thinking, and avert from him the heart-burnings incident to the course above outlined, that word shall not pass unspoken.

If, my reader, you have thoughts of growing an orange orchard, and after looking the difficulties squarely in the face, you conclude that you can overcome them; and if you would, to that end, be advised concerning approved theories and established methods, follow me through the succeeding chapters and I will lay them before you. Remember that in our age no man can afford to ignore the experience of others; and he who informs himself most thoroughly is the one who encounters least mishaps and finally commands success.

CHAPTER V.

LOCATING AN ORANGE ORCHARD.

Having determined to grow oranges, one should address himself to the task of obtaining the best of everything required;—the best location and soil; the best water right; the best trees of the best varieties; and then he should plant them and care for them in the best manner, and he may count with certainty on the best results. If he is to go through the labor and trials of growing an orchard, he may as well raise fine fruit as poor; it is not a whit harder. And besides, when it comes to returns there may be all the difference between the two that there is between profit and loss.

Best Location.—In Part I of this work, under the heading "A Glance at Our Orange Growing Country" and subsequent chapters, I have discussed the question of localities suited to citrus culture quite fully, with reference especially to this connection. It is sufficient to reiterate here that all authorities agree in recommending the high mesa lands and the interior valleys, where conditions of soil, climate and water supply are suitable.

Soil.—The soil should be loose, well drained and warm;—no standing water within twenty feet of the surface—and if there be a hard-pan at all, it should be deep. The orange flourishes best in a sandy or gravelly loam. Quite a variety of soils exists, all of which seem to fill the requirements of the orange in nearly equal degree. I note the following:

Disintegrated granite with vegetable deposit.

Gravely alluvium.

Sandy clay (chocolate colored).

Clayish sand (brown).

Sandy clay (reddish brown; colored by ferric acid, and known as "red land").

The best results cannot be accomplished in ground that bakes and packs hard under the action of water and sun, even though such ground be rich in all the chemical elements required in tree growth. Hence, adobe and stiff clay soils are to be avoided. Standing water near the surface is detrimental because it keeps the ground cold. A shallow hard-pan is a disadvantage because it arrests the growth of the tap root and stunts the tree.

Exposure.—On rolling or elevated lands a southern, southeastern or southwestern exposure is desirable. The orange luxuriates in warmth, and the more the tree and the ground in which it stands are exposed to the direct rays of the sun the better.

Water.—Be sure to get a good water supply and have it convenient for application. But, withal, use it sparingly at first. Your supply will stand you in good stead in a dry season and after your trees come into bearing, when they must have irrigation to yield paying crops. This subject will be more fully discussed in the chapter on Irrigation to follow.

Winds.—Do not locate where your orchard will be exposed to severe winds. Quite a large proportion of fruit is lost every year by being whipped against thorns and branches, and the trees themselves are sometimes half stripped of leaves. If you have reason to apprehend an occasional wind storm, plant a double row of eucalyptus, pepper or cypress trees about the orchard for a wind-break. Cypress or pepper are preferable, because they do not exhaust the soil to such a distance as the eucalyptus. Some foothill localities excellently suited for orange growing in every other respect, are unavailable because they chance to align some mountain gorge and are swept by the daily currents of air from inland to ocean, and *vice versa*. Beware of such places.

Avoiding Frosts.—If you follow the advice given in these articles and locate your orchard on the foothills or in the high interior valleys, you will be in little danger from frost. Inasmuch as cold air is denser and heavier than warm, the cold weather most prevails in low places. It is the good fortune of our country to have its cold spells of short duration, and consequently the natural basins are never quite filled up, and the isothermal line of damaging frosts does not rise over the higher altitudes.

Look out for Rocks.—If you select land on the mesas, especially in granite

formation, beware of rocks. These mesas are built up by the wash from the mountains, and many places that look comparatively smooth are only filled-up beds of former ravines; just below the surface they are chock full of bowlders. If you see only a few of these fellows cropping out here and there, regard them as a just cause of suspicion and make a thorough investigation. As the surface is usually covered with a thick growth of chapparal you may not see half the rocks that are really above ground. A little neglect in this important part of the investigation may cost you several hundreds of dollars and many a weary day's labor. Take warning from a man who has been through the mill.

CHAPTER VI.

CLEARING AND PREPARING LAND.

CLEARING.—Mesa lands, by reason of their usually thick growth of chapparal and occasional timber, are more difficult to clear than lands in the valley. The usual method is to grub out by the root everything in the form of tree or shrub. In the case of heavy oak and sycamore timber a considerable excavation is made, uncovering the hole and reaching the main tap root of the tree. This root is cut at the depth of two to four feet from the surface of the ground, and when the main laterals are also severed the tree topples over. Thus the stump is wrenched from the earth, and disposed of much more readily and cheaply than by any of the old methods of burning, blowing up or twisting out with horse-power.

IMPLEMENTS.—The implements requisite for clearing are the mattock, or grub-hoe, axe, shovel, and crow-bar. When timber is to be cut up the cross-cut saw comes into play also. With ordinary greasewood and sage roots the mattock is sufficient. Sumacs, alders and thorns require more digging and chopping.

THE EASIEST METHOD.—It is possible sometimes when the chapparal is not very heavy and that all sage, or sage with a sprinkling of greasewood, to substitute horse-power for manual labor, with a great saving in time and expense. In such cases a heavy timber or a railroad rail is dragged broadside over the ground, a horse being hitched at each end. This operation may be repeated in an opposite direction, and the result is that substantially all of the brittle stalks are broken off close to the ground. A horse-rake is of service in raking the brush into windrows, after which it is stacked and burned. The roots, which still remain in the ground, are thrown out by a heavy breaking-up plow, drawn by four horses, and it is necessary to send men over the ground to collect them into heaps for burning or hauling off. This wholesale method of clearing chapparal land is rarely feasible.

THE SLOW AND SURE WAY.—The majority of men who open up small foothills farms find there is nothing for it but to grub out the brush "by main force and awkwardness."

FUEL.—Although the clearing involves a deal of labor, and that of the hardest kind, there is a compensation in the firewood secured. All of the roots named, with the single exception of the sage, are serviceable for fuel. From thirty acres of chapparal which I cleared in opening up my place I obtained wood enough to last my family four years, and sold upwards of a hundred dollars' worth besides. The idea of digging firewood out of the ground is novel to most people, but when fuel is as scarce and dear as in California, it will not do to despise the lowly origin and uncomely appearance of our greasewood and sumac roots. When dry, they make a quick, hot fire, and are especially desirable for cooking purposes. Oak timber should be worked into stovewood when green (the only time, in fact, that it can be

split,) and if marketed the returns are sufficient to pay quite handsomely above the cost of clearing.

Cactus Land.—I have said that the mesas are more difficult to clear than the valleys; but I should except those low-land localities which are covered with cactus. This pestiferous growth, known by the Mexican name '*Tune*, is a succession of green, pulpy leaves, one growing atop of the other, and all covered with little bunches of thorns like cambric needles. The best way to get them off the ground is to tie a long rope around a clump and drag it away with horses. Taken in detail, it is chopped in pieces with an axe and handled with a pitchfork. The '*tunes* are too green to burn, and must be hauled to some out-of-the-way place. In time a part will dry up or decay, and a part will take root and grow again if not chopped up a second time. Cactus land has the reputation of being strong, and it is generally mellow and well suited to trees and vines.

Time to Begin Clearing.—Some valley land requires no clearing whatever, but is ready for the breaking plow at any time when sufficiently moist. It is a good plan to begin clearing land in the latter part of summer or early fall, so that it may be ready for the plow as soon as the first winter rains soften the ground. The time allowed for clearing may be short or long according to the acreage and the force employed, but of one thing you may be certain: it is likely to prove a harder and longer job than you calculate. Therefore, begin early, and allow ample lee-way in your plans.

Clearing away Rocks.—If you have been so unfortunate as to select a rocky piece of ground, there is nothing for it but to dig the rocks out and haul them away; then plow and dig and haul again, and in the course of a year or two, with semi-annual gatherings, your place may be reasonably clear. With rocky land, allow twice or thrice the time required for clearing chapparal.

Plowing.—As soon as possible after the first penetrating rains have fallen, start the plow, and give your land a thorough breaking up. The plow should penetrate at least twelve inches. Then, if circumstances allow, let the piece remain a month or more to air-slack and pulverize, after which, cross-plow and harrow thoroughly. It is important that the first plowing be done early, so that the land may be in condition to absorb the winter rains. The closer the last plowing approximates the planting, the better. as the soil is thus left in a mellow condition to receive the trees.

CHAPTER VII.

SELECTING TREES.

Commence Early.—The clearing and breaking disposed of, you will begin to breathe more freely, and it is then a good time to think about trees. The sooner you are in the market the better selection you will make. No harm is done by looking over the nurseries thoroughly before coming to a conclusion.

Get the Best.—I would remind you of the advice given in a former chapter, to procure only the best trees of the best varieties. By this I do not mean always the most expensive trees. A nurseryman may have six or seven year old stock, which he recommends highly and with apparent reason; and yet it might be a doubtful speculation for you to pay the fancy price he demands. Better buy younger trees of equal thrift and earn the extra dollar or two per tree by growing them yourself.

The Kind to Select.—A tree which is two years old in its budded growth, and four years old in its stock, and which is healthy and vigorous, standing from five to seven feet high, may be accounted first class. If you can obtain such, take no others. The health of a tree is best in-

dicated by the dark green of the matured foliage. If it have a yellowish cast, beware of the tree. But do not confound the sickly hue of the older leaves with the yellowish green of the new growth. The two are readily distinguishable.

A False Economy.—Do not let measures of economy induce you to buy at half the price trees that are undersized or stunted, or diseased or infested. A young orange tree which, from any cause, has been checked in its growth, is more than half ruined, and should not be subjected to the additional shock of removal. Though cared for in the best manner, it is likely to prove a losing investment. You should consider that the first cost of trees is a mere bagatelle compared with the items of land, time, and labor devoted to them to bring them to the fruiting age, and that this greater expense must be incurred for poor trees as well as for good; nay, more, the cost of raising may be greater for the poor, and you get only scrubs at last.

The Way to Economize.—If you desire to economize in your purchases, do so by selecting younger trees, but never by dispensing with thrift. Let the tree be as healthy and sturdy and large as it ought in reason to be at the age you buy it. Yearling buds on three-year-old stocks are often set. Some prefer them to the older growth.

A Good Way to Judge.—As good an index as one can have in judging of nursery stock is to note the general character of the nurseryman's place. If it have a neat, well-kept and thrifty appearance, you may almost jump at the conclusion that his young trees are in the same favorable condition. If, on the contrary, the place is out at the elbows, the chances are against the trees. Be on the lookout for stunted or diseased or scaly stocks, or any of the other ills that come from neglect. In cases where the cultivation of a nursery has been slighted, though the trees may not show it except in their lack of vigor, they are apt to die after transplanting.

Varieties.—Concerning the best varieties of budded trees, the reader is referred to the chapter on that subject. I would advise the selection of one or two varieties and the planting of these almost wholly. Uniformity of fruit is a desideratum when it comes to marketing. If you wish many varieties, plant only one or two trees of each, and leave the main body of the orchard in one kind.

Mark the Trees.—Having found the trees you want, mark them with tags or strings of some peculiar kind that the nurseryman will recognize as yours. Then make a small payment to secure them beyond a peradventure, and with the receipt in your pocket go home satisfied that you have done a good day's work.

CHAPTER VIII.

LAYING OFF THE ORCHARD.

Importance of the Work.—The operation preliminary to planting is laying off and staking the ground. Upon the accuracy with which this is done depends the symmetry of your orchard as long as it exists. The neglect or carelessness of a few hours at this juncture may result in an "eye-sore" for half a lifetime. Therefore, one can hardly be too painstaking.

Established Methods.—Every man of common sense knows, or thinks he knows, how to measure off and mark a piece of ground so that his trees will come in regular rows and the rows regularly disposed. If he goes at it by "the rule of thumb," he may or may not accomplish his purpose, but, in either event, he is likely to incur needless work and bother. It is better for him to inform himself in advance of the various labor-saving devices which have resulted from the experience of others; then adopt some method which seems to him most feasible, and consistently pursue it.

IMPLEMENTS REQUIRED.—The outfit for laying off and staking land consists of a chain, an axe, four or five flags (poles with bits of cloth fastened at the top) and a plentiful supply of stakes. Stakes a foot in length will do, but the work is nicer with laths three or four feet long, since one can sight along a row of them without getting down upon the ground too close for comfort. The flags are serviceable for designating corners and points to be seen from a long distance.

THE PLANTING CHAIN.—The best and cheapest chain that I have found is one made of annealed wires twisted about a cord and in common use as "clothes line wire." To make it serviceable for planting, fasten some large iron rings at the ends for hand-holds and space the wire off in the length decided upon for distances between trees by running a fine wire between the strands and fastening a piece of cloth or a tag thereto. The length of the chain may depend somewhat upon the length of the rows to be planted, though two hundred feet is about a maximum limit for convenient handling. In spacing the wire off, it is a good plan to make the end spaces conform to the distance adopted for the margin of the orchard, then all intermediate spaces represent distances between trees. Thus, if the margin be twelve feet and the distances between trees twenty, the chain will be thus marked:

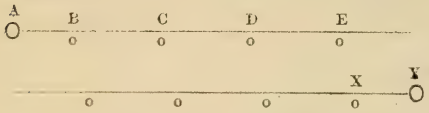


FIG. 1—PLANTING CHAIN.

A to B, 12 feet.
B to C, 20 feet.
C to D, 20 feet.
D to E, 20 feet.
X to Y, 12 feet.

A chain of heavier wire than that I have described is sometimes made in links joined with small rings, but this is objectionable on account of kinking. Rope should never be employed, as the shrinking and stretching while in use preclude anything like accuracy.

A HELPER.—The work of measuring and staking requires two people; a smart boy will do for a helper.

BOUNDARY LINES.—The first task to which one addresses himself is establishing the boundary lines of the orchard. If the land has been regularly surveyed and staked and the orchard is located in one corner or along one side of the lot, the measuring of the required distances each way to fix the orchard lines is an easy matter. But if the orchard happens to be in the middle of the farm, and there are no right angles already designated, the planter must first apply himself to

ESTABLISHING A RECTANGLE — which may be done as follows: Fix upon some line that runs parallel to the north-and-south or the east-and-west line of your place, or whatever road, field, fence, building or other object it is desired to have the orchard align. This we will call the base line.

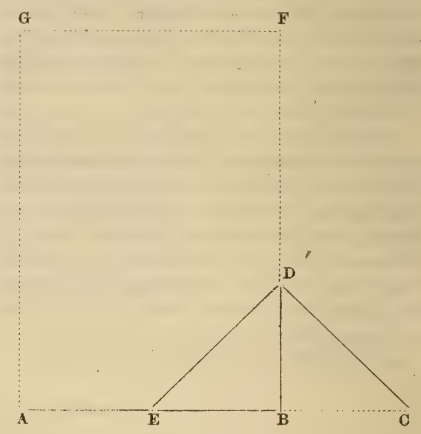


FIG. 2—ESTABLISHING A RECTANGLE.

Extend the base line A B any distance, say one hundred feet, to C. Mark the points E and C equal distances from B, say one hundred feet each. Then take a rope or chain longer than E B C (in this case three hundred feet) with a knot or tag exactly in the middle. Fasten one end of the rope at E and the other end at C; draw the rope out as shown in E D C. The knot or loop being in the middle will fall at D, giving a perpendicular to the base line A E B C. By standing at B and sighting across B D, the point F may be established at any required distance, giving a corner of the orchard ground, and then, by measurement, the point G may

also be fixed. You then have the boundary of the orchard in the form of the rectangle A B F G.

DISTANCES APART.—Orange trees are planted from ten to thirty feet apart according to their habits of growth. Dwarfs like the Mandarin may be advantageously placed ten feet apart; semi-dwarfs, such as the Washington Navel, Mediterranean Sweet, Maltese Blood and St. Michael, fifteen to twenty feet; standard trees—seedlings and native buds—twenty to thirty feet. The distances most in vogue are

Dwarfs—ten feet,
Semi-dwarfs—eighteen feet,
Standards—twenty-four feet.

CHAPTER IX.

ARRANGING AN ORCHARD—THE SQUARE SYSTEM.

THREE SYSTEMS.—There are three popular systems for the arrangement of trees in an orchard:

1st: The square system.
2d: The quincunx system.
3d: The septuple system.

It is with the first named that this chapter deals.

THE SQUARE SYSTEM.—This is the arrangement of trees in a quadrangular form; *i. e.*, so that four trees in two proximate rows form a figure of a quadrangle, thus:

FIG. 3.

The general ouline of the orchard also becomes a quadrangle if the rows are of equal length and number throughout. The system thus carried out is illustrated in Fig 4.

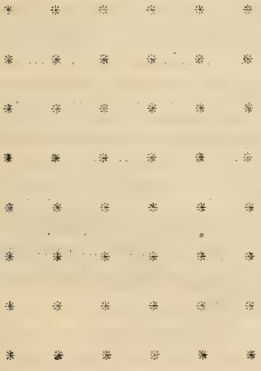


FIG. 4—THE SQUARE SYSTEM.

HOW TO STAKE BY THIS SYSTEM.—The boundary lines of the orchard ground being already established, determine how much margin you will leave between the outside rows of trees and the boundary lines. It is generally inexpedient to plant trees directly upon the outer lines, as that would bring the orchard flush with a road or fence or hedge, or with some neighbor's property. The margin usually allowed is from ten to twenty feet, according to the character of the trees and the confidence one has in the public.

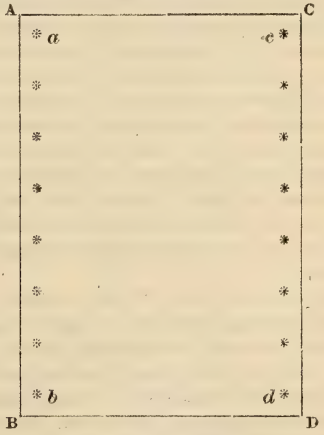


FIG. 5—CHECK-ROWS.

A B D C, boundary lines.
a b, *c d*, check-rows.

Let us take, for illustration, a margin of twelve feet. Stake the points *a*, *b*, *c* and *d* at the corners twelve feet inside the boundary lines. Place two lines of stakes, *a b*, *c d*, along opposite sides, the distance be-

tween stakes being that determined upon for the distance between rows. These lines, *a b*, *c d*, are known as check-rows. Stretch the chain across the ground from *a* to *d* and stake the first row.

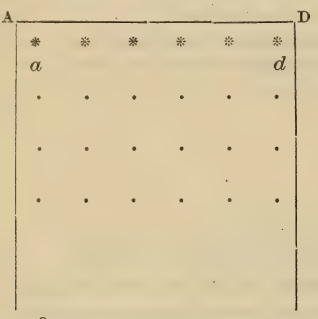


FIG. 6—THE FIRST ROW OF TREES.

This work of staking is most expeditiously done by drawing the chain tense and fastening it to the ground with an iron pin at each end. Then yourself and assistant, each with an armful of stakes, advance from your opposite stations, placing a stake at each tag until you meet in the middle of the ground. Then retrace your steps, stretch the chain for the next row and repeat the operation. It is best to make the end tag of the chain tally with the pins in one check-row all the way through. For example, if you adopt *a b*, Fig. 5, as the tally-row, do not be concerned if the last tag at the other end of the chain does not always touch the pin in the row *c d*. Make your orchard straight on one side, and let the other side take care of itself. Should the tag and pin on the off side fail to agree exactly, pull out the pin and make it conform to the tag.

REVIEWING THE WORK. — After the staking is completed it is a good plan to review the work by sighting along each row, both up and down and across the orchard. Any inaccuracies may thus be detected in time for correction. When it comes to this operation of sighting, you will find it an advantage if the stakes have been set in the ground at a perpendicular. Don't question this statement until you cast your eye along a line of irregularly leaning stakes and see how confusing it is.

NUMBER OF TREES TO THE ACRE.—To compute the number of trees that can be planted on an acre by the square system:

RULE.—1st, *Multiply the distance apart in the row by the distance between rows. This will give the number of square feet occupied by each tree.*

2d, *Divide* 43,560, *the number of square feet in an acre, by the number of square feet occupied by each tree, and the quotient will be the number of trees to the acre.*

EXAMPLE.—How many trees on an acre if planted 22 by 24 feet apart?

$22 \times 24 = 528$.

$43{,}560 \div 528 = 82.5$. Ans., say 82 trees to the acre.

For convenience of reference the following table is given:

NUMBER OF TREES TO THE ACRE.

Distance apart.	Number.
10 x 10	436
10 x 12	363
10 x 14	311
10 x 16	272
12 x 12	302
12 x 14	259
12 x 16	227
12 x 18	202
14 x 14	222
14 x 16	199
14 x 18	173
14 x 20	156
16 x 16	170
16 x 18	151
16 x 20	136
16 x 22	124
18 x 18	134
18 x 20	121
18 x 22	110
18 x 24	101
20 x 20	109
20 x 22	99
20 x 24	91
21 x 21	99
22 x 22	90
22 x 24	82
24 x 24	76
25 x 25	70
26 x 26	64
28 x 28	56
30 x 30	48

NOTE.—In these computations the fraction is dropped when amounting to one-half or less; when exceeding one-half one is taken.

CHAPTER X.

THE QUINCUNX SYSTEM.

QUINCUNX DEFINED.—Webster defines the word quincunx as follows: "An arrangement or disposition of things by fives in a square, one being placed in the middle of the square; especially an arrangement as of trees, in squares, consisting of five trees, one at each corner, and a fifth in the middle, this order being repeated indefinitely so as to form a regular group, with rows, or ranks, running in various directions."

ILLUSTRATION.—The quincunx figure is thus illustrated:

FIG. 7—QUINCUNX.

Extended in a regular group it becomes the following:

FIG. 8—QUINCUNX GROUP.

HOW QUINCUNX PLANTING IS AVAILABLE.—This system of planting is resorted to mainly under the following conditions:

1st. By those who have orchards already planted on the square system, and who wish to increase the number of trees without enlarging the area.

2d. By those who wish to plant both citrus and deciduous trees in the same orchard with a view, generally, of cutting away the deciduous trees when the citrus come into bearing. With Quincunx planting they can at pleasure dispense with the middle tree in each group of five, and leave the remaining orchard in regular rows.

3d. Quincunx is also employed in the planting of seedling and budded orange trees in the same orchard, the four corners of the square being occupied by standard trees and the middle points by budded varieties, which make a lesser growth.

HOW TO STAKE ON THE QUINCUNX SYSTEM.—Stake the two check rows the same as for square planting except that you double the number of stakes. For example, if the trees in the square are to be twenty-four feet apart, with an extra quincunx tree in the middle, place the stakes in the check rows twelve feet apart.

ARRANGING THE PLANTING CHAIN.—To the planting chain attach an extra tag, as X, Fig. 9, one-half the established distance from the tag A.

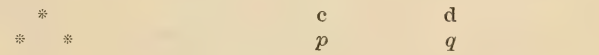


FIG. 9—THE PLANTING CHAIN ARRANGED.

EXPLANATION.—Assuming that the established distance between trees is twenty-four feet, then from X to A is 12 feet; A to B 24 feet, etc.

THE PROCESS OF STAKING.—Stretch the chain for the first row, allowing the tag A (Fig. 9) to fall upon the pin a, Fig. 10.

a	b
n	*o*
c	d
p	*q*
e	f
r	*s*
g	h

FIG. 10—THE CHECK ROWS—QUINCUNX.

For the second row, let the tag X fall upon the pin *n*. Proceed with the staking as usual, placing a pin at each tag in the chain. The result of changing the check tags A and X is to bring the trees alternately opposite each other, thus:

FIG. 11—ALTERNATELY OPPOSITE.

It is necessary to tally with the tag A in each odd row, and with the tag X in each even row, thus A, X, A, X; shifting the chain back and forth like a shuttlecock. This will bring the orchard in regular quincunx order, as shown in Fig. 8.

PULL UP UNNECESSARY STAKES.—The staker should be careful to pull up all the intermediate stakes in the check rows, as *n*, *o*, *p*, *q*, *r*, *s*, etc., Fig. 10, since they are merely check stakes and do not denote places for trees like the stakes a, b, c, etc. The stakes marked *o*, Fig. 12, are the ones to come out; their work is done as soon as the chain is stretched.

FIG. 12—*o*, *o*, *o*, *o*, SHOWING STAKES TO BE PULLED.

DISTANCE APART.—In planting quincunx, it is advisable to have the trees in regular squares not less than twenty-four feet apart; and they may sometimes be placed thirty feet apart with advantage. At twenty-four feet apart the distance from the trees on the square to the middle tree is about seventeen feet. On a scale of thirty feet, this intermediate distance becomes about twenty feet.

NUMBER OF TREES TO THE ACRE.—To ascertain the number of trees to the acre by the Quincunx system, observe the following:

RULE.—1st. *Compute the number of trees in the regular squares, as shown in Chapter X.*

2d. *Multiply this result by two.*

3d. *From the product subtract the number of intermediate (Quincunx) trees on two sides of the orchard, plus* 1.

EXAMPLE.—How many trees on an acre of ground planted Quincunx, the trees on regular squares being twenty-four feet apart?

The table, Chapter X, shows that at twenty-four feet apart, Square system, there are 76 trees to the acre.

$76 \times 2 = 152$.

$152 - *(8 + 8 + 1) = 135$. Ans., 135 trees.

ANOTHER RULE.—An approximate rule for finding the number of trees to an acre, quincunx, is to ascertain the number of trees on the regular squares, and add 78 per cent. thereto.

*NOTE.—It is assumed that the acre of ground taken for illustration is in a square form, and that there are eight intermediate or Quincunx trees along each side. The (8 + 8 + 1) represents the inside trees along two sides, plus one, as given in the rule.

CHAPTER XI.

THE SEPTUPLE SYSTEM.

A MISNOMER CORRECTED.—The system of planting which I designate Septuple has hitherto been known as Quincunx, the term being applied almost indiscriminately to this system and the one described in the preceding chapter. Great confusion has resulted from this misapplication and conflict of terms, some writers even going to the length of calling the Septuple "the true Quincunx," and repudiating the other, or genuine Quincunx system, altogether. This is error carried to the point of fanaticism, and offers no reasonable way out of the dilemma. Clearly there are two distinct systems of planting here confounded, and they ought to be designated by different names. It is manifest by the definition quoted in the preceding chapter that there *is* an old-established and well-defined system of planting known as Quincunx; that it is by fives—four trees on a square and one in the middle—as shown in the illustration. To this system, then, the title properly belongs. If some other system is devised which comprehends the planting of trees in an essentially different group—say by sevens instead of fives—it is clearly a misnomer to call that system Quincunx also. At the risk, then, of stirring up a hornet's

nest among horticultural writers, I venture to correct the error that has been tolerated so long.

WHY SEPTUPLE.—This system I call the Septuple because it is made up of regular groups of seven. The geometrical figure formed by this group is that of a hexagon, with a tree at each angle and a tree in the middle, thus:

* *

* * *

* *

FIG. 13—THE SEPTUPLE GROUP.

NOTE—It is possible to resolve the trees planted by this system into groups of five, but they do not form a regular equilateral figure. Thus, in Fig. 0, it is seen at a glance that the figure formed is not a square, hence cannot come within Webster's definition of quincunx.

* *

*

* *

FIG. 0—SHOWING MISAPPLICATION OF TERM QUINCUNX

The complete orchard is resolvable into a succession of these groups, matched together like the blocks in a hexagon quilt.

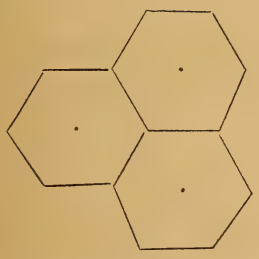


FIG. 14—SEPTUPLE GROUPS.

NO PRACTICAL BEARING.—Of course, the fact that trees planted on this system, or on any other, are resolvable into groups cuts no figure in the practical work of planting or cultivating the orchard. Neither will one readily discover this geometrical peculiarity on inspecting the trees themselves. On the contrary, between the Quincunx and Septuple planted orchards, scarcely any difference is observable on casual inspection.

THE DIFFERENCE.—But there is a difference, and an essential one in the economy of planting. Taking the figure of the uincunx, for example, we see that the trees stand at irregular distances apart.

A B

e

C D

FIG. 15—IRREGULAR DISTANCES APART.

Thus, the established square distance being twenty-four feet, A and B are twenty-four feet apart; likewise B and D D and C, and C and A. But the distance from each one of these trees to *e* is seventeen feet (approximately). Hence it happens that, while the rows up and down the orchard and transversely may be too open (24 feet), the diagonal rows (from A to D and B to C) may be too close (17 feet).

With the septuple system, this difficulty is entirely obviated, as each tree is equidistant from all proximate trees.

A B

F G C

E D

FIG. 16—TREES EQUIDISTANT.

Thus, from A to B and B to C and thence around the hexagon, the spaces are the same, and these spaces also equal the lines A G, B G, C G, D G, etc.

THE ADVANTAGE.—Herein lies the great advantage of Septuple planting, making it, in my opinion, the finest system ever devised. Upon a given space, allowing the same distances between trees, fifteen per cent more trees may be planted Septuple than by the Square system. This seems at first glance impossible, but it is nevertheless a fact. A gain of fifteen per cent in the productive capacity of land is not to be ignored. Many merchants handle goods on a margin of fifteen per cent, and many farmers may find that fifteen per cent turns the scale in their profit and loss account. There are other practical advantages in the Septuple system. As the trees come in equally spaced rows, in four different ways, they may be cultivated with advantage in as many directions, making each cultivation criss-cross several others. In irrigating, water may sometimes be run down the diagonal rows with great advantage. Especially is this true where the orchard is located on sloping land and the fall is too great to allow the running of water down the straight rows.

NOT DIFFICULT.—The novice should not allow himself to be dazed by the multiplicity of geometrical figures which I have given in explaining the nomenclature of the system. It does not require a surveyor to stake off the orchard ground in Septuple form. On the contrary, when you once grasp the theory you will find it as easy as any other system.

SEPTUPLE ILLUSTRATED.—To give an ocular demonstration of an orchard planted by this system, I present a diagram after the manner of those in preceding chapters:

FIG. 17—SEPTUPLE ORCHARD ILLUSTRATED.

METHOD OF STAKING.—The staking is done in substantially the same way as described in the Quincunx planting. Run two check-rows of stakes along opposite sides of the orchard, and, in using the chain, alternate the check-tags as previously described. By shifting the chain back and forth the trees are brought alternately opposite (Fig. 11).

KEY TO THE SEPTUPLE SYSTEM.—It is in setting the stakes in the check-rows that the difference between this and all other systems occurs. This must be explained at length. In Fig. 18 it is plainly observable that the trees in opposite rows arrange themselves in triangles.

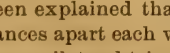


*FIG. 18—TRIANGULAR ARRANGEMENT.

It has been explained that the trees are equal distances apart each way, and hence A B C is an equilateral triangle. Now, we have the simple geometrical problem:—Given an equilateral triangle, A B C, to find its altitude.

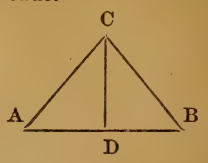


FIG. 19—AN EQUILATERAL TRIANGLE TO FIND ITS ALTITUDE.

Drop a perpendicular from the apex C upon the base A B. Then A D C is a rightangle triangle. The dimension of the side A C is known. The dimension of A D is one-half of A B. We wish to ascertain the dimension C D. The formula is:

$$\sqrt{(A\,C^2 - A\,D^2)} = CD$$

If the trees are planted twenty feet apart, we have the problem in figures thus:

$$\sqrt{(20^2 - 10^2)} = x.$$

SOLUTION.

$20^2 = 400.$

$10^2 = 100.$

$400 - 100 = 300.$

$\sqrt{300} = 17\frac{3}{8}$ (nearly), or 17 feet 4 inches.

ANSWER.—If A C is twenty feet and A D ten feet, then the distance from C to D is seventeen feet and four inches.

The orchard being staked on the Septuple system, with the trees twenty feet apart, the stakes in the check-rows should be seventeen feet and four inches apart.

Having staked the check-rows the required distance, proceed to stretch the chain and set the stakes exactly as described in Quincunx planting. Remember the injunction there given to pull out alternate stakes in the check-rows when you are through with them. (See Fig. 12.)

DISTANCE FOR CHECK-ROWS.—For convenience of reference, I append a table, showing the distances at which the check-stakes should be set for various spaces:

10	feet apart	8	feet	8	inches.
12	"	10	"	4 2-5	"
14	"	12	"	⅞	"
16	"	13	"	10½	"
18	"	15	"	7	"
20	"	17	"	4	"
21	"	18	"	2¼	"
22	"	19	"	⅞	"
24	"	20	"	9½	"

NUMBER OF TREES TO THE ACRE.—To ascertain the number of trees to the acre, Septuple planting.

RULE.—*Calculate the number set the same distance apart on the Square system, and add fifteen per cent.*

NUMBER OF TREES TO THE ACRE.

	Square.	Septuple.
10 feet apart	435	500
12 "	302	347
14 "	222	255
16 feet apart	170	195
18 "	134	154
20 "	109	125
21 "	99	114
22 "	90	103
24 "	75	86

*NOTE—This system, with equal propriety, might be termed the Triangular system. I have preferred, however, to denominate it the Septuple, following the analogy of the Quincunx—a group about a central tree.

CHAPTER XII.

TAKING TREES FROM NURSERY.

TIME.—In determining the time for transplanting orange trees we should consider, first, the condition of the trees: second, the season.

The orange tree has several periods of growth during the year. It would be impossible to define exactly these growing seasons, or even to state their number, so much do they vary in different trees and under different conditions of health and vigor, irrigation, cultivation, etc.; but there are certain times when nearly all orange trees are dormant, and other times when nearly all are growing.

THE DORMANT STAGE.— In transplanting orange trees it is best to take them in their dormant stage, as they do not then feel the shock of removal as much as when they are active. Approaching a general rule as nearly as possible I may give the dormant periods as follows:

Middle of March to the middle of April.

The month of June.

The month of September.

Middle of November to the middle of December.

THE VARIOUS SEASONS.—Many people transplant trees in March-April season with excellent results. The danger to be provided against at that time is in the cold weather which is likely to prevail. If the roots suffer a chill the tree is irretrievably stunted if not killed outright. June is the most popular time for planting, and, all things considered, the best, as neither excessive cool nor hot weather is encountered, and the season of strongest growth following, exercises a powerful influence in starting the tree upon its new life. I have known trees planted in September to thrive finely, though few people plant at that time. November and December planting is not in vogue at all.

TRIMMING TREES BEFORE TRANSPLANTING.—It is a good plan to prune nursery stock quite heavily a week or ten days before transplanting. This gives the trees a chance to recover from one shock before encountering the second. The shock of pruning has a tendency also to throw the tree into a more complete dormant condition, when it suffers least from the laceration of the roots.

It is a universal rule in horticulture that in transplanting a tree, the top should be cut away in proportion to the loss of roots. With orange trees this is almost a *sine qua non*. If the trees are not pruned before removal they should be pruned directly afterwards, and the knife should be used vigorously. I know an experienced grower who follows the rule of depriving his lemon trees of *every leaf* at the time of transplanting. He claims that they start more readily for this heroic treatment, and I am not prepared to dispute his hypothesis.

THREE METHODS OF TRANSPLANTING.—There are three common methods of transplanting citrus trees:

1st. Balling or sacking the roots.

2d. Puddling the roots.

3d. Packing the roots in damp straw.

BALLING.—This is undoubtedly the best method, though the most laborious and expensive. Trees that are carefully balled and well planted seldom lose their leaves, and, with the next succeeding period of growth, are almost sure to make a start. The operation of balling is thus performed:

A trench fourteen to sixteen inches deep is dug along one side of the nursery row cutting the earth about six inches from the stalks. Then the digger takes a sharp-edged spade, and by carefully working under from the bottom of the trench exposes the tap root. This he severs by a well directed blow or two. Next, vertical cuts are made in the soil on each side of the tree transversely with the trench, and a block of earth about a foot each way is formed. This block is carefully shaved off and rounded. Lastly, the spade is inserted in the side opposite the trench, and the ball is loosened from the contiguous ground. A little more shaving makes it symmetrical all round. The ball thus formed should be grasped with both hands, and the tree lifted from its place and set upon the half of a grain bag already provided and spread upon the ground close by. It generally happens that the end of the tap root projects an inch or two below the ball of earth. Accordingly a little slit is made in the middle of the grain bag, through which the end of root protrudes. The edges of the bag are then drawn up tightly about the ball, and fastened by winding with bailing rope or stitched with stout twine. If the ball is tied, the rope is first wound about it vertically with a hitch around the stock at the top and another about the tap root at the bottom to hold the wrap in place. Two vertical wraps are made, crossing each other at right angles, top and bottom, and a third turn is made about the ball horizontally, describing an equator about the two former meridians. The whole being made snug and tight so that the enclosed earth cannot shake loose from the roots, the balling is complete. Balled trees should be handled very carefully, and not transported long distances in a lumber wagon if a spring wagon is to be had for the purpose.

BROKEN BALLS.—If by any mischance the dirt is crumbled within the sack the wrappings should be removed entirely upon planting the tree.

CONDITION OF THE SOIL FOR BALLING.—From the description given of the process of balling, it must be evident to the reader that the soil should have a good degree of coherence to allow so much handling. A clayish sandy soil is best for balling. But the most favorable soil even, must be taken at just the proper time to make the operation successful. About the third or fourth day after a rain or an irrigation is a safe time to begin sacking.

WHEN SACKING IS NOT DESIRABLE.—It is not best to sack trees if they are taken from a stiff clay soil, or any soil, in fact, that is likely to bake hard. If the balls of earth become thus set they enclose the roots like a mold of plaster of Paris, and the tree cannot thrive.

PUDDLING.—In this method of transplanting, the trench is first excavated and the tap roots cut as previously described. No effort is made, however, to preserve the earth intact about the roots. The tree being loosened, it is left standing in the trench with a shovelfull of dirt upon the roots to keep them from drying. A puddle is formed at some convenient point by mixing loam and clay to the consistancy of thick cream. A sufficient number of trees having been dug, they are gathered up, a few at a time, and the roots of each immersed in the puddle. They are thus encased with a film of soil which protects them from the drying action of the air. As an additional precaution, the roots are parked in damp straw for transit. For shipment long distances, a number of trees may be bunched together and their roots packed with damp straw in a barrel. The stocks and tops are generally wrapped with burlap, rushes or other material as a means of protection. The only objection I have ever heard urged against puddling trees is that the film of earth is sometimes set so firmly upon the small roots that it chokes them, after the manner of the baked or hardened ball already alluded to.

PACKING IN DAMP STRAW.—With this method the tree is prepared in the same manner as just described, except that the puddling operation is omitted. I have

transplanted trees by this method as well as by puddling and balling, and I find that the damp straw alone answers every requirement.

The principal precaution to be observed in transplanting orange trees is to avoid the contact of air with the roots. If the roots be thoroughly dried, the vitality of the tree is lost.

CHAPTER XIII.

PLANTING AN ORCHARD.

DIGGING THE HOLES.—The stakes for the orchard having been set as described in a preceding chapter, the next operation is digging the holes.

SIZE OF HOLES.—If the ground has been properly prepared, there is no necessity for digging the hole larger than requisite for admitting the roots of the tree. If the trees are balled, a hole large enough to receive the ball is sufficient; if not balled, make it large enough to admit the roots in a natural position, *i. e.* without doubling on themselves. For the average three or four-year-old stock a hole eighteen to twenty inches across and the same depth is ample.

THE PLANTING BOARD.—A device in almost universal use for fixing the point where the tree should stand is known as the planting board.

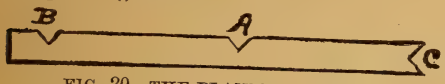


FIG. 20—THE PLANTING BOARD.

It is a light strip about five feet long, with a notch (A) cut in the middle, and notches B and C at the extremities, as shown in the figure.

MANNER OF USING THE BOARD.—When about to dig the hole place the board on the ground so that the central notch A shall fit against the stake. Stick pins at notches B and C. The board may now be removed and the original stake at A pulled up and the hole dug in its place. When planting the tree, the exact place where it should stand is fixed by replacing the board so that the notches B and C fit upon their respective pegs, and the tree standing in the hole, is held upright at the notch A.

It is not necessary that the board be always laid on a parallel with the orchard lines, as a little variation in the angle will make no difference in determining the middle point; but it is essential that the board be placed on the same side of the stakes each time. For example, if it is on the south side of the stake when the pins at the extremities are stuck, then it should be adjusted to these pins exactly in the same manner when the tree is set and the board be on the south side of the tree. To avoid confusion it is best to follow one rule throughout the orchard, placing the board always on the same side of the stakes.

THROWING THE DIRT.—In digging the holes it is best to throw the dirt clear of the pegs so that it shall not interfere with the replacing of the board. In localities where the surface earth is richer than the subsoil, painstaking planters throw the top earth in a pile by itself so that it can be first returned to the hole, about the roots, and the poorer soil filled in at the top.

PLANTING.—Two men work together to the greatest advantage in planting—one to place the board and hold the tree, and the other to shovel in the earth. The operation is thus very quickly performed. If the trees are sacked, the balls are placed in the holes without disturbing the wrapping, which will shortly rot away and offer no impediment to the growing roots. If not sacked do not take them from their packing of straw until ready to plant each in turn. Then handle with as much celerity as possible without slighting the work. The lateral roots should be carefully arranged in the hole so that they lie in a natural position, none being doubled up or crossed.

LACERATED ROOTS.—If the tap root or laterals are lacerated, cut away the injured

part. It is easier for the tree to make new roots than to heal up old ones.

DEPTH.—The tree should be planted the same depth that it was in nursery.

FILLING.—I have found it best to fill the hole only about half full, leaving a basin to receive water and then complete the filling after irrigation.

SETTLING THE EARTH.—It is not necessary to spend time tramping the earth down upon the roots, as the water to be applied will settle it more effectually than it is possible to do with the foot.

IRRIGATING.—Citrus trees should always be irrigated as soon as planted. Run the basin at each tree full, and after the water has soaked away, fill in with dry earth, which prevents evaporation.

STRAIGHTENING UP.—When all are planted go through the orchard and right up such trees as may be found leaning.

ADDITIONAL PRUNING.—If the tree shows a tendency to wilt, it is a good plan to prune it still further, even cutting away to a few leaves or none at all.

INDICATIONS.—If a tree wilts and the leaves cling to their stems, becoming dry and dead, the chances are that the tree is lost. If the leaves drop off, the tree will almost surely put forth new ones.

WASHING THE TREES.—If the trees are infested with any sort of scale or smut, wash them thoroughly with soap suds, scrubbing the stocks and spraying the tops. It is but fair to give them a clean start.

WRAPPING THE STOCKS.—If rabbits or rodents are apt to prove troublesome, it is a good plan to wrap the stocks with paper and tie lightly with twine. This keeps the animals from gnawing the bark. The wrapping is also a good protection to the young and tender stocks against the hot sun. Some people whitewash their trees instead of wrapping them and are well pleased with the result.

DESIGNATING VARIETIES.—If you plant several varieties of trees, the best way to keep track of them is to make a diagram of the orchard in some convenient book of record, designating varieties by numbered rows. Tags on trees are a nuisance, and besides, soon become weather-worn and obliterated. The same is true of lettered stakes in the orchard ground.

LOST TIME.—The orange tree in transplanting loses a year's growth; this under the most favorable circumstances. I do not mean to say that it utterly fails to grow the first year after removal, but that the check which it sustains reduces its average size to that of trees a year younger, not transplanted.

NEW GROWTH.—At the next succeeding season of growth, if the conditions are all favorable, the tree puts forth new shoots from the stock and branches. Often these shoots make their first appearance upon the stock, and cover it with a thick growth down to the very ground.

WATER SPROUTS.—These shoots, below the point where they are serviceable as branches, are called water-sprouts, and they must be trimmed off at the earliest practicable opportunity. However it is not always advisable to break off these sprouts as soon as they appear. If the upper part of the tree has started new growth simultaneously with the stock, then the stock should be cleared, and the earlier the better. Rub off the incipient shoots when no bigger than the point of a pin and the vitality of the tree will go into the top, provided the top is ready to receive it. But when the water-sprouts are the only growth the tree attempts to make, it is advisable to let them remain for the good they may do. The leaves thus put forth will elaborate the sap and start the vital forces of the tree throughout. With the additional strength thus gained the top buds, in turn will be pushed forth, and when these shall have formed branches and leaves the water-sprouts may be safely dispensed with. Should the top utterly fail to grow, and become dead, the topmost or most vigorous of the water-sprouts may be preserved to form a new stock and top.

SUCKERS.—This growth which starts from the crown of the roots just below the surface of the ground should be cut off as soon as discovered, as it will sap the life of the tree if allowed to grow. Only in one instance is there an exception to the rule of destruction of suckers. If you are satisfied the main stock is dead or likely to die, the sucker may be left to form a new tree. But bear in mind, the sucker tree will be a seedling.

SLOW STARTING.—Sometimes a tree manifests no signs of growing at the first or second or third season after transplanting. Sometimes while maintaining a healthy hue of stock and limb, it remains dormant a whole year. In such cases there is nothing to do but to see that the tree has sufficient irrigation and cultivation, and await results. When it finally starts, as start it will, the lost time may be in a great measure retrived by the extra vigor of growth.

BACKSETS.—When newly transplanted trees are frosted or preyed upon by grasshoppers, gophers, squirrels, rabbits or other pests—the foliage destroyed and the bark injured—they may languish for the first year and make a start in the second.

STUNTED TREES.—A second or third backset, however, and sometimes the first if severe, is sufficient to stunt the tree. When satisfied that a tree is stunted, the best thing you can do is to dig it up and throw it away. It might, with careful nursing, make out to live, but its existence would be sickly and unprofitable. Do not waste your labor upon it.

CHAPTER XIV.

CULTIVATION.

OBJECT OF CULTIVATION.—All soils, loose and compact alike, form a sort of crust upon the surface under the action of rain and sunshine. Scientists tell us that the fine particles thus pressed together form a series of ducts or flues, which by capillary attraction suck up the moisture from beneath and send it off in the form of vapor. The first office of cultivation is to break up these ducts, and thus summarily check the loss of moisture from the soil. The second office of cultivation is to destroy the weeds, for they, too, draw up, appropriate to their own use and evaporate a share of the moisture. The whole end and object of cultivation then is to conserve the supply of water in the earth. It would be well if this fact were more constantly borne in mind. Some people think that if they cultivate enough to keep the weeds out of their orchards they fulfill every requirement. This is not the case. They are merely attending to one of the incidentals of cultivation.

CULTIVATION *versus* IRRIGATION.—It is saidthat the most successful ph ysician is he who directs his efforts towards aiding Nature in the work of recuperation. So, I may say, the most successful cultivator is the one who most aids Nature to preserve her store of moisture. In setting out to raise an orchard, were I given my choice of cultivation without irrigation or irrigation without cultivation, I would unhesitatingly pin my faith to cultivation alone. In the case of orange trees it has been demonstrated by Dr. O. H. Congar, of Pasadena, that they may be grown in his locality without any artificial supply of water, but he concedes that, to obtain profitable results from trees *in bearing*, they must be irrigated. Probably the middle ground, which comprehends thorough cultivation and judicious irrigation is best, even in bringing an orchard up to the bearing point. Herein many of the old growers made a fatal mistake. They flooded the ground a half dozen times a year and did not stir it half enough. The result is manifest in stunted, gnarled and diseased trees—trees that produce inferior fruit and are dead when they ought to be in their prime.

WHEN AND HOW TO CULTIVATE—PLOWING.—As soon as the rainy season is well inaugurated it is best to plow the orchard ground with a single plow, throwing a furrow against the trees on each side, and leaving a dead furrow in the middle between the rows. This mellows the soil so that it is in the best condition to drink up the rains, and, should there be a surplus of water it will run to the dead furrows instead of standing about the trees to their detriment. In case the orchard is located on sloping ground, it is best to run the furrows diagonally down the decline, as they thus furnish an easy fall for the surplus water. If the furrows lead directly down

the descent the soil washes badly; and if they are made transversely the water collects, breaks over and runs straight down, washing the soil as much as in the former instance. The single plowing in the fall or early winter I regard as ample for this kind of cultivation, if the soil is reasonably loose. Should it be of such character, however, as to be considerably compacted by the winter rains, another plowing in early spring is required. At most, do not plow more than twice in a year. After the dry season has set in, deep cultivation causes evaporation rather than retarding it. In plowing be careful not to go too deep in the first half dozen furrows next the trees. Avoid lacerating the roots which may lie near the surface, though I will say frankly that if they are close enough to be much interfered with by a single plow, it is a bad sign—a sign of too much irrigation.

Cultivating.—Aside from the one or two plowings, the rest of the year's work is done with the cultivator, followed, in some instances, by the harrow or clod crusher or "slicker." Many kinds of cultivators are in use, from the old-style hand implement, drawn by one horse, to the Acme and others, with a seat for the driver, and requiring two, three or four horses. In selecting an implement, the orchardist must be guided by the requirements of his ground and the amplitude of his purse. Each implement in use is probably best adapted to some particular soil. If the ground is stony, one kind may not work at all; if inclined to break up in clods, another may be useless. Study your requirements and see what your neighbors use and like best before you invest in an implement. During the spring months it is a good plan to cultivate after every rain. Each rain may prove the last of the season, you know, and it will not do to lose any moisture that may be husbanded for the long, dry summer. For soils that are more or less stiff, a clod-crusher, constructed of planks, to drag over the ground and mash down the lumps is in general use. Some growers employ, on more mellow soils, a "slicker," an implement not altogether unlike a stone-boat, by which the surface is reduced to a fine tilth and smoothed off like a shirt bosom. This gives an orchard a most tidy and well-kept appearance after cultivation, and is practical as well as æsthetic. The harrow is occasionally used to run over the ground and break the lumps or the crust that may have formed after a rain. I would not advise a very constant use of the harrow, however, as its effect is to pack the soil just below the surface. There is also more likelihood of injury to the trees from it. In all the cultivation of the orchard, I must enjoin the greatest care. Both a steady horse and a steady and experienced man should be employed, or great, perhaps irreparable, damage may result. It is a good plan to use a short single-tree or to wrap the ends with cloths to avoid barking the trees.

After the rains are over, it is necessary that the orchard ground be at all times in a mellow condition and free from weeds. For this, one cultivation a month generally suffices. A cultivation should follow each irrigation if water has been run on the surface at all. To make a clean job of weed exterminating, I have found it best to let a man follow the cultivator with a hoe and chop up everything that escapes the implement. Some of the three and four-horse cultivators have weed cutters attached, but even with them it is necessary to hoe the weeds close to the trees.

Judgment the Best Monitor.—If the orchardist have a knowledge of the theory of cultivation, his own judgment will be the best guide as to when and how the work should be done. Only let him be thorough if he would command success.

CHAPTER XV.

IRRIGATION.

The Irrigating Season.—From the first of April to the first of November may be accounted California's rainless season. There are exceptions, of course, as in the year 1884, when rain fell in all these so-called dry months except July; but, tak-

ing one year with another and averaging the longer with the shorter seasons, the seven-months rule will hold good. It is during this rainless period that irrigation becomes necessary to sustain vegetable life. Formerly irrigation was much more general and frequent than in latter years. Within a comparatively recent period it has been determined that thorough cultivation will, in a great measure, reduce the necessity of applying water artificially, and, in the case of many varieties of grapes and deciduous trees, irrigation may be dispensed with entirely. Orange trees to thrive well and bring forth profitable crops, must be irrigated.

Over-Irrigation to be Avoided.—It is a mistake, however, to suppose that because some water is good, a great deal more water is better. No error is more pernicious or, in the end, more certainly ruinous to trees than excessive irrigation.

In 1877 a committee of the Sonthern California Horticultural Society, appointed to investigate the matter of irrigation, made a valuable report, which was summarized in the following paragraph:

"The systems of irrigation in use throughout the district are varied. Many use the old system of flooding the entire ground every three or four weeks, using water to the exclusion of cultivation. Others irrigate less and cultivate more. We find, in fact, all phases of irrigation and cultivation, from all water and no work to all work and no water. Neither extreme is profitable, but a golden mean of two or three thorough irrigations, with thoroguh cultivation, your committee believe the orchardist will find the most successful. On heavy soils the water should not touch the tree and great care should be exercised after each irrigation that the ground may not bake."

A Matter of Education.—When the ground about the tree is frequently flooded, the roots are drawn to the surface. The tree then becomes more sensitive to every change of moisture, and if water is not applied at the regular and frequent intervals to which the tree has been accustomed, it wilts and droops. It is not to be supposed that the best of human care can furnish a supply equal to the storage reservoirs of nature which lie deeper in the earth, and to which the roots ought to be encouraged to go for their supplies. Trees are creatures of habit no less than men, and, "as the twig is bent, the tree's inclined." It is best to commence this education early; if you postpone it too long your orchard is likely to prove a lot of spoiled children on your hands.

How Much to Irrigate.—During the first summer after planting young orange trees, it may be necessary to water them every month or six weeks. Make it a point to be thorough with your work when you do irrigate. Let the water penetrate deep, and assist the young roots in working down. Do not under any circumstances, allow the ground to remain after irrigating in a sodden condition, to bake hard and evaporate the moisture almost as rapidly as it was applied. A tree thus neglected is soon in a worse condition than it would have been if it had received no irrigation at all. I have found it the best plan in treating young trees to excavate a considerable basin about each tree and fill this basin with water once or even twice if deemed necessary. Then, after the water has entirely soaked away, fill the basin with *dry earth*. This covering acts as a mulch, preventing the evaporation of the water applied, and the tree is prepared to wait a long time for another drink. The second summer, trees will flourish with three or four irrigations, and the third summer they will thrive with two or three.

Want of Irrigation—How Manifested.—Be governed by circumstances. If you see that a tree is suffering, as indicated by curled or wilted and leathery leaves and drooping stems, do not delay the application of water. It needs help at once. If you follow the plan here indicated and do your work thoroughly, you will find these calls less and less frequent as the tree obtains its foothold on terra firma. You will then have brought it up in the way it should go, and it will reward you in future by a healthy and profitable life and a minimum of labor exacted for its sustenance. It is not advisable to leave the tree until it hangs out its signals of distress before applying water. Keep a sharp watch over your orchard and you may detect the premonitory symptoms in one or

two trees. Then you know the whole orchard will shortly be in the same condition, and it is time to begin another irrigation. Although the orange is a hardy tree, and, when watered, quickly revives from a most distressed condition, it is better that this check to its grouth be avoided altogether by keeping it constantly fresh and vigorous.

Various Methods of Irrigation.—There are many different ways of irrigating trees, each one adapted to its locality and circumstances.

The Old Way—Flooding.—On the most level lands of the valley water is run in ditches or zanjas and turned into the orchard, flooding the entire surface. This method of running water in open ditches implies three things: 1st—An abundance of water; 2d—nearly level land; 3d—a tolerably compact soil, so that the water is carried in the ditch without too great wastage. After the irrigation the entire surface should be cultivated.

The Basin Method.—A more modern and better system consists in turning the water into baisins made about the trees. The baisin may be round or square, and consists of a ridge or dyke thrown up to retain the water about the trees until it seeps away. Latterly a plow has been invented for throwing up these ridges, and a man and a team can make with it a hundred baisins a day. The size of the basin increases with the age of the tree, the plan usually followed being to make it as broad as the overhanging top. When the trees are full-grown these baisins are generally made contiguous, so that nearly the entire surface of the ground is flooded.

Irrigating in Furrows. — Another plan is to run two or three furrows along each side of a row of trees, and graduate the supply of water so that it will fill all the furrows without overflowing. In this manner the water is allowed to run from six to twelve hours, and by seepage the ground is thoroughly moistened along the entire row. If the head of water is sufficient, a number of rows may be watered simultaneously, the supply for each being diverted from the main stream. The arrangement for this purpose is a flume running along the highest side of the orchard. From this flume the irrigating furrows lead out at right angles, and the water is supplied to them through auger-holes in the side of the flume.

Sub-Irrigation.—A few years ago some Los Angeles gentlemen patented a system of sub-irrigation, and it has been introduced to a slight extent. It consists of a series of concrete pipes laid in the ground deep enough to escape the cultivator, and through them water is conveyed and applied directly to the roots of every tree in an orchard. An ingenuous machine worked by hand makes and lays the pipe simultaneously, turning it out (pardon the simile) very much as a butcher turns out bologna sausages with his stuffer. The pipe is thus made continuous, and there are no joints to bother either in the making or the leaking afterward. A plug of established size allows a little of the water to exude beneath each tree, and it gradually seeps through the soil, furnishing a reliable supply, and that applied where it will do the most good. Of course quite a complicated system of pipes is required, with a main running from the water supply and laterals extending along each row of trees or between each two rows. There is also a piece of pipe set vertically over each irrigating orifice, extending to the surface, like a miniature well. This receives the water as discharged allowing it gradually to soak away, and at the same time prevents the earth from baking over the orifice and closing it up. The only mechanical objection I have to the system is its complication and the likelihood of its getting out of order. There is also danger of destroying the vertical pipes or wells in cultivation. A still more serious objection is the great cost, which amounts to something like fifty or sixty dollars an acre. This system has been in use for some years in a number of places in Southern California, and has generally given satisfaction. There is by this method a great saving in the labor of irrigating as well as in working the ground. The water being applied beneath the surface, does the tree the utmost possible good and at the same time does not start the weeds or cause the ground to bake. The invention is as meritorious as it is ingenious.

An improvement on the above-named system of sub-irrigation has been invented and patented by Mr. L. M. Holt, of Riverside, and is in process of introduction. It comprehends a system of pipes as recounted, but dispenses with the vertical wells, which are referred to as objectionable.

Mesa Irrigation.— On the mesas it frequently happens that the irrigating stream is not large enough to allow of the first three methods named; or that the pitch of the ground is too abrupt and the soil too porous to admit of the running of water in open ditches at all. Here the most painstaking and economical methods are in vogue. The water is generally distributed in wooden flumes or in cement or iron pipes, and applied directly to basins made about the trees. With water confined in a pipe, under pressure, and a section of hose to apply it with, a man may do quite as good execution as with a considerable head flowing by gravitation in a ditch. The advantage of the pipe and hose method is in the direct and easy application and the avoidance of all wastage.

Distributing by Barrels. — Where pipes and flumes are not available, water is sometimes distributed in barrels or tank wagons. A hose-bibb is usually fastened in each tank or barrel, with hose attached, and the team hauls the wagon along as rapidly as the basins are filled. This is a somewhat slow and expensive method of irrigation, however, and is resorted to only when more ready means of distribution are not available.

Cultivating After Irrigating. — Where the basin method is employed, and dry earth shoveled in to cover all the soil that is wet, as well as where sub-irrigation is in use, a cultivation is by no means imperative; but with all flooding methods the cultivation should invariably follow.

Mulching. — Some people apply a mulch of straw to the basin surfaces after irrigation and thus avoid cultivating. But this system has its drawbacks. There is almost certain to be enough grain in the straw to seed the ground, and bring forth a crop which requires more labor in the hoeing up than the thorough cultivation of the soil would have amounted to.

Do Not Cultivate Too Soon.—With clayey soils, and in fact with all of a stiff nature it will not do to cultivate directly after irrigating. A practiced eye is required to tell just when the ground may be stirred without danger of breaking it up into lumps and clods.

CHAPTER XVI.

PRUNING.

Objects.—In pruning the orange tree there are two objects in view—

1st. To give it symmetry.

2d. To make it healthy and productive. No part of the orchardist's work is more entertaining than this, because it furnishes intellectual as well as manual occupation. Every tree is a study. I may go further, and say that every tree is a new study, for there is such an infinite variety in the combinations of stocks, branches and stems that novel applications of the general principles of pruning occur in each instance. A man who would prune successfully must keep up a constant thinking, and should be prepared to give a good and sufficient reason for every cut he makes. His employment is like that of the sculptor, for he is transforming an ungainly object into one of beauty; but unlike the sculptor, the pruner must cut deep, calculating to a nicety how nature may be relied on to round out the contour. It is necessary that the pruner keep an ideal constantly in mind, and that from the earliest stages of his work he strive for the accomplishment of his ideal. To this end he should thoroughly inform himself in advance of the general theory of pruning; of the various systems employed and the one that is best adapted to his own orchard.

Two Systems of Pruning.—There are two systems in vogue, one known as high pruning, the other as low pruning. Low pruning is resorted to with lemons and the dwarf and semi-dwarf varieties of budded oranges. It consists simply in forming the head of the tree close to the ground—say within a foot or two of the surface—and modeling the growth somewhat after a shrub. The high system prunes away the branches near the ground, exposing the trunk and forming a conventional tree top. This method is employed with nearly all seedling trees that grow to the standard size, and with a considerable portion of the lemons and budded oranges.

The Low System. — The advantages claimed for this method of pruning are—

1st. That the head of the tree being brought close to the ground, the picking of the fruit is greatly facilitated.

2d. That the trunk is closely shaded, thereby preventing sunburn and other evils coming from too much exposure to the weather.

3d. That the soil immediately about the tree is shaded and the moisture thus preserved.

With this method of pruning also the branches are usually "shortened in" and this results in a fourth advantage in that the fruit is borne closer to the body of the tree, and the branches being rendered stocky from the cutting back, are not likely to break down with their burden. The tree with low head and shortened branches needs no props in the fruiting season. This method of low pruning is much employed at Riverside, in San Bernardino county, where many of our most progressive orange growers are to be found. The exemplification there given must certainly convince one of its advantages in the respects claimed. For semi-dwarf and dwarf-budded orange trees, low pruning is the system I would recommend. The objection usually urged against it is the difficulty of working close to the tree with the cultivator, by reason of the low-hanging branches. This can be obviated by choosing a cultivator to meet the special requirements. An evil to be guarded against is the thickening of the top—the great multiplication of branches as a result of the shortening process .

This difficulty may be overcome by a free use of the knife, keeping the top open enough to admit a circulation of air, and the tree will then be as healthy as though the top were four or five feet higher and proportionately broader. In the case of lemons, the theory has been advanced that they bear much better with low pruning than with high, as this manner of growth must closely conform to the natural habit of the tree. It should be borne in mind that low pruning does not contemplate an abandonment of the tree to its own sweet will and way in growing. Neither is it allowable to leave suckers from the roots or water sprouts from the lower trunk. As close and careful attention is required in low pruning as in high.

High Pruning — Young Stock. — In pruning young stock by the high system it is well to make haste slowly—*i. e.*, cut away the lower branches only as the tree thickens its stock and throws its vitality into the upper top. It is conceded that about the proper proportion for a standard tree is two-thirds top and one-third stock. With quite young trees the proportion of top may be greater than this with good advantage. Lateral branches growing close to the ground have a tendency to thicken the stock and make it upright and self-sustaining. Above all, avoid trimming young trees up to mere switches, with just a tuft of leaves at the top. There can be no more certain method of making them crooked and weakly. As good a general rule as I can lay down is, to keep the tree well proportioned and symmetrical at all stages of its growth. After the first year in orchard, the two-thirds rule as regards the top may be closely followed. The main forks of the tree may be established at the height of four to six feet from the ground with seedlings and at three to four feet with budded varieties. Remember that the trunk of the tree grows but very little longitudinally and that the height of the top must be regulated by cutting away the lower branches. If a standard tree is properly and reasonably pruned, the contour of the top when viewed from a distance will be not unlike the almost perfect sphere of the fruit it bears.

PRUNING—IMPLEMENTS REQUIRED.—A pair of gloves to protect the hands from the thorns; a sharp knife, a small saw, and some paint or wax to cover the stubs of large branches; this is the outfit for a pruner. The pruning shears are much in use, but I do not like them except for clipping the ends of branches. When applied to severing a branch at the trunk, they leave a stub which is not to be tolerated, and if this be pared away by the knife the work is doubled. If one prunes his trees from their youth up, he grows in knowledge with them, so to speak, and while they are never much at fault, he is never at great loss to know how they should be treated. But to undertake the pruning of older trees which have been allowed to grow half wild, and bring them to a state of civilization—there's the rub. It is vastly better, of course, that they should never reach that vexatious stage, but when such is the case there is nothing for it but heroic treatment. When Governor Stoneman purchased his estate in San Gabriel, fifteen or twenty years ago, the grove of old oranges on the place was almost unproductive. He sent his foreman into it with knife and saw, under instructions to prune out half of the tops. After performing his task the man reported to the Governor, stating by the way that he though he had ruined the trees. Governor Stoneman took a look at the orchard and sent him back to prune still further. The result was that the next year there was a fine crop of oranges.

PRUNING YOUNG TREES.—The best plan is to go over them quite frequently—as much as three or four times a year—and prune lightly each time.

TIME OF PRUNING.—Whenever the tree is in a dormant condition it may be pruned advantageously. December is a popular time for this work; also late in the spring before the heavy July - August growth commences, and just following the gathering of the oranges.

THUMB PRUNING.—This consists of rubbing off with thumb or finger shoots before they form any woody fiber. The practice is quite allowable, and indeed to be commended under certain restrictions. On general principles, it conduces more to the welfare of the tree to stop an undesirable limb before it has made much growth than to let it grow on only to be sacrificed at last with greater shock and loss of vitality to the tree. But I would advise great conservatism in pruning young trees just starting. This is a critical time with the tree and it needs a breathing surface. If the leaves which it throws out for this purpose should happen to be in the wrong place, it is often better to leave them until the tree gets it breath, *i. e.*, hardens its new growth and makes other leaves to elaborate its sap. Anything approaching a general pruning of an orange tree while making new growth should be avoided, as the operation is likely to check all further growth for that period and may stunt the tree.

PRUNING OLDER TREES. — The novice looking at a neglected tree, with its tangle of branches, is dumbfounded with the task of pruning. Let him but go at the work systematically, however, and he will find the plan of the mighty maze.

A FEW RULES FOR PRUNING.—1st. Begin at the ground and cut away all suckers growing from the crown of the roots. Dig, if necessary, to the place where the sucker issues from the root and cut away the little protuberance from which the sprout grows.

2d. Cut away all water-sprouts growing from the trunk of the tree. Remove the knots or little protuberances here also, paring smooth with the trunk.

3d. Work along the trunk into the top of the tree, and cut away all small, dwarfed branches which have neither vitality to make a large growth nor room to make it in.

4th. Lop off such main branches as throw the top out of equilibrium or destroy its symmetry.

5th. Cut away all minor branches that are superfluous. Consider a branch superfluous (*a*) when it crosses another or conflicts with another in any way; (*b*) when it grows directly above another, and would at some future time, conflict it; (*c*) when there are parallel branches too close together, a part must be taken away; (*d*) when a number of branches have put out from the end of a shortened limb, one, two or three only should be left.

6th. Having thinned the top sufficiently

from within, survey it externally and lop off the ends of such branches as destroy the regularity of outline.

A tree thus thinned out admits a free circulation of air, which is as good in a sanitary point of view as fresh air for an individual. The tree is then able to cope with its enemy the scale and smut, and its fruit is cleaner, larger and better therefor.

HINTS ABOUT THE WORK.—In cutting a limb of good size, the neatest method is to saw it from below, raising the limb gradually so that it shall not pinch the saw. In this way a smooth cut may be made close to the body of the tree and there is no danger that the limb in falling may strip off a portion of bark from the trunk. If the limb must be sawed from above, first cut the bark below to avoid the tearing away referred to.

Do not leave a stub of a limb protruding from the trunk or a main branch. Cut smooth and close up in order that the bark may readily close over the wound.

In cases where limbs of half an inch or more in diameter are sawed, it is a good plan to daub the cut surface with paint or grafting wax to prevent it from drying out and checking.

CHAPTER XVII

FERTILIZING.

In one respect the orange growers of California are behind the times. They cultivate thoroughly, irrigate scientifically and appreciate the value of good pruning; they know the book of insect pests from Genesis to Exodus; they grow the best fruit of the best varieties known; they gather freely and in riches increase and multiply, *but they do not replenish the earth.* By this single dereliction they approve themselves short-sighted, improvident—gathering for themselves to impoverish their children; building for a day, not for all time.

There are old orange groves in Los Angeles county that scarcely pay the cost of cultivation;—trees in a semi-dormant condition the greater part of the time, with leaves of a sickly yellow color and fruit small, leathery of pulp and lacking in flavor. These trees have been undergoing a process of starvation for ten, fifteen or twenty years. It is a wonder that they have maintained the unequal struggle so long. Indeed, had it not been for the degree of fertilization which comes from the application of water in repeated irrigations they would probably have succumbed long ago. It is not in reason that any soil can sustain the continual demand made upon it for the formation of a larger tree and the annual production of a crop of fruit without becoming exhausted. Groves in this impoverished condition need to be renovated, first by a heavy pruning of the trees, and second by a thorough renewal of the soil. With this stimulus the trees will make a new start and regain their former productiveness.

In Florida, and in most other countries where orange growing is prosecuted as a scientific industry, much attention is paid to fertilizing. Rev. T. W. Moore, in his work on orange culture in Florida, says:

"No crop feeds more ravenously than the orange, and none will convert so large an amount of suitable fertilizers into fruit so profitably. Much of our Florida land will produce and sustain fine trees for a few years without the aid of manure; but after some years of fruiting the leaves will begin to turn yellow, indicating a deficiency in the soil." He then discusses the various fertilizers in use, naming the commercial compounds of ground bone, potash and sulphuric acid, Peruvian guano, land plaster, green crops turned under, stable manure, and swamp muck.

In California not one of these fertilizers is in use, unless it be stable manure in exceptional instances. The reason that our fruit growers have paid so little atten-

tion to this subject is mainly due, I think, to their unwitting renewal of the soil by irrigation, making it possible for trees thus sustained to flourish and bear good crops for a number of years. No attention was paid to the matter of fertilizing *per se* and so cultivators thought, if they thought at all on the subject, that their trees were doing well enough without manures and would never require them. Had the renewal of the soil been a more marked necessity it would have elicited more attention.

Fertilization by Water.—Irrigation fertilizes the soil in two ways:

1st. By the mechanical action of the water, which takes up the fine particles of vegetable matter in passing along the ditches and deposits them as a silt in the basins about the trees.

2d. By the chemical elements contained in the water itself.

A propos of this subject I here present an analysis of the water of the Los Angeles river, made by Prof. E. W. Hilgard, of the University of California:

Total residue of sample tested 17.53 grains per gallon, of which 8.37 grains consisted of common Glauber's salts, etc., and 9.16 grains carbonate of lime, magnesia and silica. The detailed analysis is as follows:

Chloride of sodium (common salt)...	1.004
Sulphate of sodium (Glauber's salts)..	7.369
Carbonate of lime.....	0.382
Carbonate of magnesia.....	4.287
Silica.....	1.171
Sulphate of lime.....	0.776
Phosphate of lime	2.182
Iron and magnesia carbonates	0.259
Alumina.....	0.100
	17.530

The water of the Los Angeles river is primarily derived from the mountains, the same as nearly all of the irrigating water used in Southern California, and while there may be a great variation in the chemical constituents of different streams and springs it is probable that all are more or less charged with fertilizing elements.

The Fertilizing to be Considered in Irrigation.—Orange growers, if they are wise, will consider the fertilizing effect of water in irrigation and strive to make the most of it. In this connection I wish to caution them against the plan somewhat in vogue of allowing water to run in channels along a row of trees, the portion not absorbed flowing away as waste. By this method the mechanical fertilization previously referred to, is entirely lost More than this, the very soil about the trees is robbed of some of its best elements, all being carried away to enrich some adjoining field, or mayhap, the roadside. When we consider irrigation in this light, the basin method is by far the more preferable.

Water Fertilization Not Sufficient.—While I am disposed to allow full measure of importance to the fertilizing which comes from irrigation, I would enjoin the fact that this alone is not sufficient. The old groves alluded to, which have exhausted their partially renovated soils, are proof of this theory.

Substantial Fertilizers Required.—A full grown orange tree maintains a wealth of foliage, forms new wood and leaves five or six times annually and produces from one to five thousand oranges. The organism from which all this is required deserves good food and plenty of it.

Manures at Hand.—Nearly every fruit grower has at hand the means of fertilizing his orchard properly if he will only devote sufficient attention to the subject. Instead of allowing the refuse of his barn yard to dry out and burn out through the long summer and to leach away in winter, he should have it preserved and applied to the orchard ground.

A Compost Heap.—A good way is to establish a compost heap at some place convenient for wetting down during the summer. A water-tight vat, built in the ground or slightly depressed is best, but a mere excavation where the earth is compact will suffice. Into this let all the barn yard refuse be thrown, together with all the bones that are available, and all the ashes from the house. In lieu of a plentiful supply of ashes muriate of potash may be used, which will thoroughly decompose the bones. Let the compost heap be wet occasionally to facilitate decomposition, and if too much heat is generated let the mass be forked over. In this way a large quantity of the best fertilizing matter may

be accumulated in the course of a year, and the cost will be merely nominal.

Applying the Manure.—As soon as the winter rains are well started the manure may be applied to the orchard. Care should be taken not to heap it about the bodies of the trees. It is of very little use there in any event, and may do harm. It should be spread over the ground as far as the lateral roots extend and, with large trees, the whole surface of the ground may be covered with advantage. Turn it in with a plow, and the work is done. The rains will carry the soluble elements down into the earth, making them available for the roots, and the fibrous matter will be incorporated with the surface soil to its great benefit. Stiff soils are thus rendered more friable, and sandy soils more loamy. Both will be susceptible to finer tilth and will retain moisture the better therefor.

Artificial Fertilizers.—When California orange growers shall have utilized the cheap fertilizers at hand, which now go to waste, and then feel the necessity for more concentrated manures, it will be time to talk to them about the manufactured article. My object at present is to urge upon them the subject of fertilizing in the main. If they do it at all they will do it well. I believe the home-made compost heap, as outlined above, would furnish all that is required in the way of fertilizers at a tithe of the expense of the commercial compounds.

Let the California orange grower renew his soil in some way, and the sooner he begins this task the better.

CHAPTER XVIII.

ENEMIES OF THE ORANGE TREE.

The orange tree has its enemies;—so have we all. Probably the horde of orange tree pests is no more numerous or implacable than that which preys upon our other domestic trees; but when it comes to numbering and cataloguing them—aye, or fighting them either—they seem formidable enough. It is this numbering and cataloguing and studying their habits which painstaking men have performed for us that has placed within our hands the weapons for their destruction. Let nobody be appalled by the array of orange-tree pests presented in these and subsequent pages; they do not all attack at once, and by taking them in detail and following prescribed methods, every one of them can be vanquished.

The Gopher.—This is a little animal resembling a rat; somewhat more compactly built and with shovel teeth and a stubby tail. He burrows in the ground and is almost a universal pest in California. He is especially destructive with orange trees because he attacks the roots, many times doing the utmost damage without giving evidence upon the surface that he is at work. The first indication, perhaps, is the wilting of the leaves, and then, when one seeks the cause, the tree topples over, the main root having been eaten entirely away. In attacking large trees the gopher's method is to girdle the main stock just below the surface and then destroy the lateral roots by peeling away the bark.

How to Fight Him.—The way to serve the gopher is to carry the war into Africa, and fight a battle of extermination. Do not wait for him to attack a tree. As soon as you discover his mound of earth thrown up anywhere in the orchard, or near it, open hostilities.

Poison.—I have found crystals of strychnine one of the handiest and surest means of giving the gopher his quietus. I provide myself with a little bottle or box of poisoned raisins which I keep constantly in my pocket while about the farm. Then, upon discovering a gopher mound I dig it away and work down until the hole is exposed. A couple of the raisins are thrown in as far as they will go and the gopher is left to his fate. Sometimes, hower, he resists temptation to the extent of filling the hole and throwing the

raisins up with the dirt. Then it is necessary to dig and try it again. If he refuses the raisin bait entirely, try him with a wedge of poisoned watermelon, or a piece of carrot or turnip or sweet potato. Never give up until you are sure that the gopher is dead. If allowed to remain he will surely do some mischief and, what is worse, he will soon have a family to join him in his marauding. After poisoning a hole, you will generally find it filled up, but if there are no after evidences of work in that vicinity you may conclude that the poison has been effective. As previously remarked, strychnine is the best destroyer. Pulverize the crystals snd insert only a little of the powder in the bait. Arsenic will not serve at all; the gopher fattens on it.

Traps.—Several patterns of gopher traps are in use, the best of which are skeleton claws, which are inserted in the hole and close with a spring upon the gopher when he pushes the trigger. In setting them it is best to dig down to the main runaway and place the trap as nearly on a level as possible. Then cover the hole with something to exclude the light. The most successful trap I have ever found is called the Cushing, and is constructed of wire, with a sheet-iron trigger. It has "a very taking way" with the gophers.

Squirrels.—Another burrowing pest is the ground squirrel. He has his nest below ground and a hole for entrance and exit much larger than the gopher hole, which he always leaves open. He does not attack the roots of a tree unless they happen to be in his way while tunneling. The damage which he does the orange tree is in gnawing the bark of the trunk.

Exterminators.—Squirrels are exterminated by poison and by fumigations with apparatus gotten up for the purpose of driving bi-sulphide or carbon gas or brimstone smoke into their holes. Wrapping or whitewashing the trees, as suggested in the chapter on planting, is a good means of protection against squirrels. These pests are by no means so universal as gophers and are more easily disposed of.

Rabbits.—Both the Jack and the "Cotton Tail" rabbit are destructive enemies to the orange tree, gnawing the bark as high as they can reach. Wrapping or whitewashing the trunk is a protection against them. Some people suspend bits of bright tin in their trees, the glint of which in either sunlight or moonlight, frightens the depredators away. Another method is to smear the trunks with diluted blood. The rabbit has a fine sense of smell, and this offense to his olfactories keeps him away. Rabbits are disposed of with the shot gun with double advantage, if one has time to hunt them. Otherwise poison may be used or the services of a good dog or cat invoked. When one starts an orchard in a comparatively new and wild region, all measures of protection seem ineffectual except a rabbit-tight fence.

Grasshoppers.—In newly settled localities grasshoppers are apt to prove troublesome for a number of years, or until all the contiguous lands are brought under cultivation. Plowing the ground seems to kill their eggs and put an end to the nuisance. When grasshoppers prevail to a considerable extent they destroy young orange trees by denuding them of leaves and even stripping the bark from the tender shoots. The best protection to small trees is to wrap the stocks with paper or cloth and enclose the top in a grain bag or other covering. Chickens are of great service in making war upon grasshoppers. I have colonized my flocks in the orange orchard with the most satisfactory results to the chickens and the trees.

Scale Insects.—The most formidable enemies, after all, are the scale insects; probably because they are the most insignificant. They belong to a low order of animal life known as coccidæ. I shall not here attempt a techinal description of the scale insects, but will rather refer the reader to the scientific discussion of the subject taken fron the work of Hon. Matthew Cooke and appearing as an appendix to this work. I cannot too highly commend the efforts of Mr. Cooke in behalf of the fruit growers of our State. They owe him a debt of gratitude which must needs be paid in installments by successive generations. For the fullest information relative to insects injurious to all tree and plant life I take pleasure in

referring my readers to Mr. Cooke's work.*

THE BLACK SCALE.—This is the most common, and is considered the least dangerous of the scale family. It may exist in a tree a long time without destroying it, but we may be sure the effect is constantly deleterious. The scale appears in all tints from a whity yellow of the newly-hatched to a brown of middle age and black in maturity, and in form is a little blister adhering to leaf, stem or stock. It does not attach itself to the fruit. Trees thus infested should be thoroughly pruned and washed with a solution of whale-oil soap as directed in the appendix.

FUNGUS, OR SMUT.—This is an attendant of the black scale. Scientific investigation has shown that the scale excretes a gummy substance called honey-dew, which, in falling, attaches to the upper surfaces of leaves, twigs and fruit. This gum holds the dust that chances to fall upon the surfaces covered by it, and the mass generates a fungus growth termed back smut. This smut, although seeming to do no damage to the tree other than to render it unsightly, must retard its growth by obstructing the stomata or air-breathing surfaces of leaves and branches. It also renders the fruit unsalable, or nearly so. Neither scale nor smut should be tolerated in an orchard. The whale-oil soap solution extirpates both.

THE RED SCALE.—This is similar to the black scale, except that it is somewhat smaller and of a reddish color. It adheres only to the under side of leaves and to the fruit, and avoids the limbs and trunk. The red scale is more dangerous than the black and, if unmolested, will utterly destroy an orchard in a few years. For treatment see Appendix.

THE WHITE OR COTTONY CUSHION SCALE.—This approaches more nearly to a distinct animal than either of the other scales and is the most dangerous of the three. For full description and manner of treatment see Appendix.

GUM DISEASE.—Lemon trees especially and orange trees occasionally, are subject to gum disease, an affection of the bark close to the ground. This is caused by injudiciuos irrigation. The bark splits and a gum exudes. If unchecked, the disease encircles the tree and kills it. The best treatment upon discovering the first symptoms of gum disease is to cut away the affected part and daub the wound with paint, wax or tar. In irrigating thereafter do not allow the water to touch the body of the tree and be sure that the soil is well stirred after each irrigation.

"Die Back" and many of the other maladies to which the orange trees of Florida and some other lands are subject are wholly unknown in this country.

*NOTE.—Injurious Insects of the Orchard, Vineyard, etc., by Matthew Cooke, late Chief Executive Horticultural Officer of California. Sacramento: H. S. Crocker & Co.

CHAPTER XIX.

WASHING TREES.

THE YOUNG ORCHARD.—When the young trees are planted in orchard it is a good plan to give them a thorough washing. Whatever of extraneous growth, either scale or smut, may be upon them is thus cleared off, and the trees are given a clean start in life, which is as valuable to them as to a man.

PREVENTIVE AS WELL AS CURE.—If the plan is followed of giving the trees a washing once or twice a year thereafter it will greatly promote their vigor and insure them against attack by the scale insect. With these pests of the orange tree the ounce of prevention is a hundred times the easiest and best.

WASHING SOVEREIGN AND IMPERATIVE.—For older trees already infested with scale, washing is the only reliable remedy. When once cleaned, they too should receive periodical sprayings and scrubbings. It might as well be accepted by the orange growers of California as an unavoidable conclusion that *all* orange trees, to be healthy, productive and long lived, *must be washed.*

THE SOLUTION in common use for this purpose is made of whale-oil or some other cheap and strong soap. For my use I have found the addition of a little concentrated lye most efficacious. The strength of the solution needs to be varied

to suit requirements. The strongest is needed in treating obstinate cases of scale. For simply washing trees to cleanse them, and as a measure of prevention I recommend the following:

A Simple Wash.—Heat the water almost to the boiling point and dissolve in it sufficient concentrated lye to make it slippery between the fingers. Then add whale-oil soap, a quarter pound to the gallon. The solution may be applied to the trees hot without danger of injuring them.

Stronger Solutions.—For stronger washes, and those of various kinds, such as tobacco mixture, coal oil emulsion, etc., see the recipes of Matthew Cooke in the Appendix to this work.

Method of Application.—A broom or a scrubbing brush is serviceable for washing the stock and main limbs of the tree. In treating the tops, the solution may be "switched" in with a broom or brush or sprayed with a hand sprinkler. The switching process is available only with small trees when the tops are well thinned out. For those of larger growth a hand sprinkler, such as shown in the accompanying illustration, is used:

FIG. 1—THE SPRAYER.

In treating an orchard of full grown seedlings, these apparatus are in turn, inadequate, and to avoid tediousness, resort must be had to a force pump like that shown in Fig. 2.

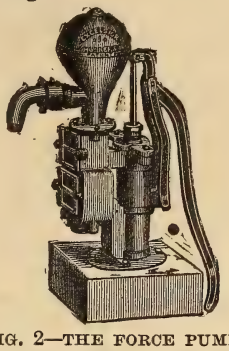


FIG. 2—THE FORCE PUMP.

The Sprayer.—Fig. 1 illustrates a hand sprayer with the nozzle attached to the piston: The bucket containing the solution is placed on the ground and the apparatus worked with both hands. This will throw a rose-spray to the heighth of twelve or fifteen feet, or a solid stream twenty feet.

The pump shown in Fig 2 is known as the Excelsior No. 1. It is generally mounted on a barrel containing the solution, and the whole apparatus is hauled about the orchard in a wagon. The advantage of this pump is that, being double acting, it throws a continuous stream. Double hose may be attached, thus giving two streams simultaneously. The wash is applied through a three-quarter inch hose twelve or fifteen feet long with a nozzle of ordinary iron pipe eight or ten feet long, which can be pushed well into the top of the tree by the operator. The spray is formed by closing the end of the pipe excepting only a thin slit. Four men make up the spraying party:—one to drive the team, one to work the pump and two to hold the nozzles. With this force at work an orchard is soon gone over.

CHAPTER XX.

WORKING, WATCHING AND WAITING.

"But the waiting time, my brothers, is the hardest time of all."

A Year or Two Lost.—As stated in a preceding chapter, the orange tree loses a year's growth in trans-planting. Under the most favorable circumstances it is not

until the second year in orchard that the tree regains its normal vigor. If in the meantime any special causes have intervened to set it back, such as the loss or partial loss of its leaves by grasshoppers, or the gnawing of its roots or stock by vermin, or injury by frost—any or all of which are liable to occur—the tree may not get a good start before the beginning of the third year after planting. If it do not show itself in a thrifty growing condition by that time, better dig it up and throw it away. I would not wait that long with a tree that gave earlier evidences of being stunted.

When Budded Trees Yield.—But if good budded trees are planted and thrive well from the start, the third year in orchard they ought to yield a little fruit, by way of sample. The fourth year they will produce more, but not enough to bring much revenue. At the end of the fifth year there should be quite a fine crop. If the trees have been retarded in any way the fruiting may be a year later. Accordingly, the man who plants an orchard of budded oranges, must expect to wait from five to six years for his first substantial proceeds.

When Seedlings Yield.—With seedling trees one must wait nine or ten years.

A Long Wait.—Five years is a long time; ten years a great deal longer. If a man is possessed of a plethoric purse he can abide the issue with equanimity; but for one who is dependant for a living upon his own energies this hiatus is a most serious matter. It is a matter which one should weigh well and provide against before embarking in the enterprise. Not only must the family have a living, but there is a continual demand for the expenditure of money or its equivalent—energy—in caring for the orchard.

Tiding Over.—Many and divers ways are resorted to by men of limited resources to tide over this period of waiting. The mechanic finds work at his trade for a part of each year; the teacher returns to teaching, and the professional man to his practice. If the previous vacation was that of a farmer the orchardist can generally find work to do near at home in caring for the places of others or in general farm labor. Some may be able to pay their way as they go from their own places. Such are to be envied most of all. It often happens, however, that the fruit farm *par excellence* is not well adapted to raising general produce. This is the case with many of the mesa locations.

Helps.—But with all farms established on a right basis there are helps to the living which prove most valuable at this period. The cow is one of these adjuncts; chickens another; the vegetable garden a third. If a man is provident he can have his patch of alfalfa and his fodder growing in odd strips and corners of the place, thereby providing, without any outlay of cash, enough feed for his cow and some to help along with the support of the other animals. Chickens, as an auxiliary, under the charge of the gentle and painstaking housewife, are not to be despised; but I warn the novice against placing too much dependence on the chicken business as a principal means of livelihood. Heretofore some people, principally dealers in fancy stock, have indulged in a good deal of hyperbole regarding the profits of the poultry yard, and some other people have believed them and have been badly disappointed.

Economy Wins.—The thrifty man, aided by his helpmeet, can devise many ways to cut down expenses and produce a little revenue pending the issue of the main horticultural venture; and those who address themselves earnestly to the task, and keep clear of debt, generally work through and find themselves on the comfortable side of independence in a few years.

Diversified Planting.—Most people who improve small places diversify their planting, *i. e.* set a portion of the farm in deciduous fruits and a portion in grapevines; and some devote consideroble space to small fruits. These come into bearing at two to four years and shorten the unproductive period correspondingly.

Advisable Crops.—In this connection it would be proper to discuss the products that may be grown in the spaces between the rows of young fruit trees, for the man who struggles to make ends meet almost invariably feels the necessity of utilizing this ground. Corn and sugar cane for domestic use or for fodder, potatoes, beets,

turnips—any of the leguminous crops—may be grown without detriment to the trees. But I would advise the planting of not more than two rows in the space between rows of trees. These crops should not come nearer than six or eight feet from the trees.

Nursery stock and small fruits may be planted in the orchard if the same rule of not overcrowding is observed.

Crops not Advisable.—All grain crops—any crops, in fact, that preclude cultivation—should be avoided as they involve great injury or total destruction of the trees. Watermelons and pumpkins are undesirable since they cover much of the ground to the exclusion of the cultivator, and their roots ramify to great distances, frequently drawing moisture directly from the roots of the trees.

Citrus and Deciduous Trees.—Some people adopt the plan of planting deciduous trees of early bearing habits—like the peach—in alternate rows between their orange trees. To this end the orchard is often planted close together with the intention of ultimately cutting away the deciduous trees when the oranges come into bearing. My experience with this method has not led me to favor it. In the first place consulting appearances, I do not like the intermixture of the two kinds of trees—citrus and deciduous. Secondly, trees of different habits need to be treated differently in irrigation, and it is generally an awkward matter to irrigate part of the trees in an orchard without watering all. Thirdly, peach and some other deciduous trees come into bearing before the oranges, it is true, but the fact also remains that they are still vigorous trees when the oranges begin to produce. In Southern California the peach tree has been known to live fifty years. The oranges will need all of the space in the orchard when the deciduous trees are still in their very prime. It is hard for one to sacrifice the result of years of toil, and hence too often the deciduous trees are left and the oranges suffer—all of the trees suffer from crowding.

An Orange Grove Pure and Simple.—If the orange grower is master of the situation, so that he does not need to raise anything in his orchard but the orange trees themselves, and can keep the whole surface well pulverized and free from extraneous growth—that is, after all, the best plan.

CHAPTER XXI.

THE ORANGE TREE IN BEARING.

Extra Care.—The orange tree when it begins to bear requires extra attention. Not only should the cultivation be most thorough, but, beginning with the time when the fruit first forms, there must be more irrigation than formerly, and every means must be adopted to keep the tree up to full vigor as it assumes its new productive function.

Tendency to Overbear.—The natural tendency of the tree is to overbear; *i. e.*, to form more fruit than it can properly mature, or at least so much that, if matured, its own vitality suffers thereby.

Thinning the Fruit.—For this reason it is imperative that the fruit first formed be thinned out with no sparing hand. If two-thirds or three-quarters of the sets are pulled off when they are the size of a hazelnut, it will be the better for the tree. How many oranges a tree should be allowed to bear the first season it would be impossible to say, as so much depends upon the size and strength of the tree, but I would place the safe limit somewhere between three and twenty. Aim to keep within rather than to pass the limit by a single orange, and the future well-being of the tree will reward you therefor. When a tree overbears at first it is generally stunted, and in such case the original yield may be its best for a number of years. In some instances the tree never produces so good fruit afterwards. The second season more liberty may be allowed in the matter of production, but both tree and owner must still practice self denial to a degree.

After Production.—The second year of bearing a budded tree may be allowed

to produce from twenty-five to fifty oranges, the third year two hundred, and thus increasing proportionately until in full bearing.

Fruit Thinning Afterwards Desirable.—The careful grower will not overlook the thinning of his fruit at any age of the tree. Thus only is the finest quality and a good uniformity of fruit to be obtained. As the trees become large the task of thinning increases to laborious proportions, but that is no reason why it should be overlooked. No greater oversight is to be charged to our orange growers generally than in their neglect to repress the over-productive tendency of their trees.

A Short Cut in Thinning.—An expeditious way of thinning the fruit adopted by some growers is to prune their trees quite heavily in June or in one of the fall months when in a dormant stage. This finds the fruit newly set or half formed, and a fair proportion of it is removed with the severed limbs. I believe this to be an excellent plan, "killing two birds with one stone," and both of them pretty good birds.

Props.—If the high system of prunning has been observed, the fruit will be borne near the extremities of long slender branches, and it is generally necessary to sustain these branches with props from the time the oranges are half grown until matured and gathered. Poles with forked ends are in general use for this purpose. If props are not used, the limbs often break with their weight of fruit and thus the grower suffers loss both in crop and tree.

Productive Capacity of Seedling.—A seedling tree at Riverside bore at nine years of age sixty oranges; the next year five hundred, and the next two thousand, when it was accounted at fullest productiveness. Not all seedling trees even when vigorous and healthful in every way can do as well as this or ought, in fact, to be allowed to produce so heavily.

Yield of Budded Fruit Less.—Semi-drawf budded varieties will never give so large a yield, tree for tree, as seedlings; but the difference is made up by the earliness of bearing, the extra number of trees to the acre, and the superior quality of the fruit.

CHAPTER XXII.

PICKING, PACKING AND SHIPPING.

Picking too Early.—The most advanced of the orange fruit, having attained about three-fourths of its normal size, begins to assume a yellowish color in December and January. Some growers, desirous of obtaining the good prices which prevail at the opening of the market, pick such oranges as appear ripe in January and February. When they do this they make a mistake. The juices are not at that time properly developed and ripened, and the fruit is sour and really unfit to eat. The short-sighted people who sell such trash do not stop to consider that for a mere temporary gain they are ruining the reputation of their fruit, and that for every dollar thus made they must ultimately lose two. The man who eats one of these sour oranges will surely think less and eat less of the fruit the rest of the season—perhaps for the rest of his natural life.

The Time of Ripening.—Oranges begin to attain their best flavor in February, and that is the time when the market should be opened. The fruit on the outer branches most exposed to the sun ripens first and is the best. That growing on the inside of the tree, besides being slower in maturing, does not color so highly and is inferior in flavor.

Long Preservation.—The orange, unlike most other fruits, does not begin to deteriorate directly after ripening, and then drop from its stem. It will hold its juices in perfect preservation from March until June, after which it suffers gradual loss, but remains palatable until August or September. All this time it maintains its place on the tree, unless subjected to

some accident, such as the pricking of a thorn or a violent shaking by the wind or other disturbing element.

A Year on the Tree.—It is not an unusual thing to find oranges hanging upon the tree a full year after maturity and when the next succeeding crop is ripe. Such old fruit, although in outward appearance as sound and handsome as ever, is found when picked to be soft, and when opened, to contain only a juiceless pith.

Oranges Should Not Be Left Too Long.—It is a bad plan to leave oranges unpicked later than March and April, at which time the tree puts forth its blossoms for the next crop. A moment's reasoning will show that the old fruit, in the effort to maintain itself, must absorb no slight quantity of the juices of the tree, and this to the detriment of the forthcoming crop. Thus the young oranges are robbed of their proper aliment, while the old grow no better, and nothing but loss results.

The Proper Season—For picking oranges is then from February to April. In the earlier part of this season I would advise a nice discrimination, in order that only the fully ripe fruit be taken. Although the color may be substanstially the same, a practiced eye and hand can easily detect the difference between the ripe and the unripe. In the latter part of the season the picker may gather the fruit clean from the tree as he goes.

The Best Picker.—Although a number of machines and devices have been invented for picking, I know of no better implement than the human hand. The man or woman who supplies the hand and the motive power therefor may stand on the ground when the tree is small, otherwise on a step-ladder. The picker twists the fruit a little to one side, and with a quick double jerk breaks the stem close up. It does not answer to pluck the orange with straight outward pull, as in that case a small patch of skin adhering to the stem is often taken out, thus ruining the orange for market.

Must Not Be Bruised.—In no case should the oranges be dropped to the ground or thrown even a few feet to their receptacle. The picker generally carries a sack slung to his shoulder.

Gather When Dry.—Oranges should not be gathered in wet weather or when there is dew on the trees, the dampness being unfavorable to the keeping qualities of the fruit.

When the picker's sack is full he deposits the contents in a pile beneath the tree, or in a box or barrel, thence to be hauled to the packing house.

Too Hasty Packing.—It has been almost a universal custom with our growers to sort and pack the fruit immediately after picking, and ship at once. I pass over without just reprobation the careless manner in which this work has usually been done. The result in demoralized markets and short returns has been shown and commented on elsewhere. For present purposes it is sufficient for me to point out the better way. Those who are joined to their idols and will not learn from experience are not likely to be admonished by a scolding.

Curing.—Although we have totally ignored the plan practiced in other countries of curing or seasoning our oranges before packing, and have succeeded fairly in making our fruit keep without it, I still think that the coming packer will adopt this system. When carried to the packing house the oranges should be spread upon shelves or racks not more than two or three layers deep, all having glaring defects being at that time rejected. The fruit is thus left from two to five days, during which a portion of the water is evaporated from the skin, leaving it more tough and elastic and not so susceptible to damage by bruising as in the fresh state. Slight blemishes not readily discoverable at first are likely to develop by this time, and the defective fruit may then be thrown out.

Sorting.—I would advise every packer to have two grades of fruit. Let him make the first grade as uniform in size and color as possible, and first class in every respect. In sorting for this he should reject

1—All fruit affected by rot.
2—All fruit pricked by thorns.
3—All fruit with skin torn or abraded.
4—All fruit that is unripe.

5—All fruit that is under-colored.

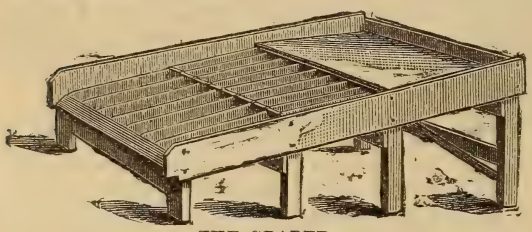
6—All fruit that is too large.

7—All fruit that is too small.

For the second class he may put in all fruit rejected from the first that is sound and ripe, irrespective of size and color.

CLEANING.—If the fruit is disfigured by smut, this should be removed with a brush before packing.

THE GRADER.—An apparatus which greatly facilitates the assorting of oranges is known as the grader, an illustration of which appears herewith:



THE GRADER.

There is no standard orange grader. The grader in use at Riverside consists of a stand 38 inches by 9½ feet in surface dimensions. It is inclined from one end to the other, the higher end standing 36 inches from the ground and the lower 18 inches. At the upper end there is a table inclined somewhat, but not so much as the rest of the apparatus; dimensions 38x33 inches. Below this there are two series of slats running lengthwise, each 40 inches long. These slats perform the office of a riddle for the oranges in process of sorting. The slats in the upper series are 2½ inches apart, and those in the lower series 3 inches apart. The fruit is first placed upon the table and then allowed to roll down the incline. The smallest fruit drops between the slats of the first series. The rest run over these slats and the next in size fall between those of the second series. The oranges that are too large for the last slats (*i. e.*, more than three inches in diameter) run off the end of the table. Thus three grades are accomplished. Beneath each of the riddles is fastend a burlap, bagging to the middle, where there is a hole allowing the oranges to roll into the receptacle provided for them. By this appliance the work of grading is accomplished very quickly and accurately.

PACKING BOXES.—Two kinds of boxes are in use: One, known as the California box, is 8 inches wide, 19 inches high and 22½ inches long. The ends are a little less than an inch thick and the sides and bottom half an inch. There are two boards on each side, between which cracks of half an inch to an inch are left for ventilation.

Another, called the Eastern box, is 13 inches wide, 13 inches high and 26 inches long, outside measurement. It is composed of the same material as the other box, but is divided into two compartments, each of which measures a cubic foot in the clear. Cracks are also left for ventilation. The Easternbox is now most favored.

WRAPPING.—Our more progressive packers are adopting the plan of wrapping each orange in paper as it is placed in the box. This involves a good deal of labor and some expense, but it also offers these advantages:

1. It is a protection to the fruit against bruising while in transit.

2. It absorbs surplus moisture, thereby preventing rot.

3. It places the fruit in the market in a tasty manner and conveys the impression that the packer at least had a good appreciation of it.

4. If the wrappers are printed, it becomes a means of advertising the producer or packer and the variety of the fruit. The buyer who likes the oranges will look for that wrapper the next time he buys.

NUMBER OF ORANGS TO THE BOX.—With the cases above described oranges run from 100 to 250 to the box. The happy medium is 150;—this for seedlings or average sized budded fruit, like the Navel or Mediterranean Sweet. Small fruit like the St. Michael will go 200 to the box on a good average.

NUMBERING THE CONTENTS.—The oranges are counted as they are packed and the number each box contains marked on one end.

BOXES WELL FILLED.—The boxes should be filled so that when the lid is put on it will press the fruit down sufficiently to prevent it from shaking about in handling.

COST OF PICKING AND PACKING.—The

Riverside Fruit Company gives the cost per box as follows:

Gathering	$0.05
Packing, including wrapping	.30
Box	.15
Total	$0.50

SHIPPING.—As soon as possible after packing the boxes should be shipped.

MARKETS.—Up to the time the Southern Pacific railroad was completed, giving direct rail communication with the East, our only market for large quantities of citrus fruits was San Francisco. Handling our products from the early times, when the fruit had not been brought to a high standard, and when the packing was uniformly bad, the San Francisco merchants got into a way of slaughtering it, and the growers of Southern California were at their mercy. Now that our people are making an effort to establish a better order of things, they find their past bad record and the settled habits of the San Franciscans against them. The metropolis of the State is therefore quite generally voted an uncertain market. This has induced producers and jobbers within the past two or three years to look eastward for the disposal of their fruits. Arizona and New Mexico are our natural fields of consumption and these have been fully supplied. Markets have been opened also in Denver, Kansas City, St. Louis, nicago, Minneapolis, and some shipments have been made as far as the Atlantic seaboard. Not all of these shipments have proven satisfactory. This fact is not to be wondered at when we consider that many of the shipments were pioneer efforts. Some of the ventures, however, were highly satisfactory. A Riverside shipper cites his experience as follows:

"My oranges sold in San Francisco last season (1884) from $2 to $4 per box. At about the same time in Denver the same class of my seedling oranges (165 to the box) sold for $7.83. Another gentleman who shipped to Denver with me received for his very choice Riverside Navels, $8.22 per box of 137. It costs about $4.20 to pay freight and commission on a box of Riverside lemons sold in Denver and $3.50 on a box of oranges. The cost of shipment to San Francisco and commission is 75 cents per box. This makes the Denver market nearly $2 per box better than San Francisco."

FREIGHTS.—The high freights of the Southern Pacific railroad* have been the chief impediment to eartern shipments. Some concessions were made by this company during the past year, but the tariff is still too high. It is to be hoped that the advent of a competing railroad, which we have in the Atlantic and Pacific, now establishing termini on this coast, will put quite a different face on the matter;—tha we shall soon have cheap access to all available Eastern markets. One thing is certain: San Francisco cannot be relied on to furnish an outlet for our vast citrus productions, and the sooner our people establish their own commercial relations with consuming markets the larger their returns.

AVOIDING THE TROUBLE OF PICKING, PACKING AND SHIPPING.—Of late years, jobbing firms of wealth and experience have come to the fore as purchasers of our citrus fruits, and the most common practice among producers is to sell their crops on the trees. They are thus relieved of all trouble and responsibility in the premises, and realize more satisfactorily than though they undertook the work themselves. The jobbers, well versed in the *modus operandi* of packing, shipping and supplying the various markets, can handle the fruit to much better advantage than individual producers.

*NOTE.—The railroad company reduced the rate on oranges last year (1884) to all points east of the Missouri river from $350 to $250 per carload; to Tucson and Benson, A. T., to $225 per carload; to Kansas City $200 per carload. The through rates two years ago were as high as $600 per car. The difference in favor of orange growers is very large, being over $1 per box. This traffic is only in its inception. Each year it will increase, and with the increase no doubt further reductions will occur.

CHAPTER XXIII.

REJUVENATING OLD TREES—BUDDING OLD TREES.

When old orange trees become sickly and practically useless by reason of exhausted vitality or insect pests they may be restored by adopting the following course; Denude the tree of leaves altogether, cutting away all of the top except the leading branches. Wash these branches and the trunk thoroughly with an insecticide and wrap the trunk in burlap to protect it from the sun. Manure the ground about the tree, and irrigate thoroughly. The tree will send out a multitude of new shoots, which should be thinned out judiciously. In one year the tree will have a fine top and in two years will begin again. In this way diseased trees may generally be entirely reclaimed.

BUDDING OLD ORANGE ORCHARDS.—The question of converting old seedling orange trees into budded trees is attracting attention on account of the high price of the Riverside Navel as compared with the seedling fruit. A letter was recently written to Mr. Alex. Craw, foreman of the Wolfskill orchards in Los Angeles, for information relative to the budding recently done on the large trees in that orchard, and the following reply was had, which was published in the Riverside PPESS AND HORTICULTURIST:

"TWOGOOD & EDWARDS—*Gentlemen:*—Yours of the 20th inst. is received, and in reply to your question relative to budding large seedling orange trees I will give you the particulars of how the trees were treated that you refer to.

"Orange budders know the difficulty of getting a bud to take in the old wood of large trees. Knowing this, and wishing to have the buds start nearer the center of the trees, I sawed off one or two of the leaders or center branches in the spring and left the side branches to fruit the next season. The branches so cut off should be painted with rubber paint. They will produce a number of young shoots. These should be thinned out to two or three, so as to shape the tree, and the remaining ones should be budded in the fall, and left as dormant buds; or they may be budded the next spring. After the fruit is all picked from the side branches, cut all upright branches back one-half, as otherwise the tendency would be to draw too much vigor from the buds. In this way you can have some fruit each year until the buds come in and commence bearing. Next season you will have a fine top and can cut away all lower branches of the seedling stock. Then wrap the trunk of the tree and the exposed limbs with cypress branches or bullrushes to prevent them from from becoming sunburnt.

"In this way Mr. Wolfskill has had ripe fruit on trees twenty months from the bud, and has made large healthy trees besides."

Mr. Craw is one of the most experienced orchardists in Southern California, especially in the management of the orange and lemon. He has recently converted a large orchard of seedling orange trees to budded fruit in a most skillful manner, and the *modus operandi* is given above very briefly.

CHAPTER XXIV.

ANALYSES OF RIVERSIDE ORANGES AND LEMONS.

The following is the University Experiment Station Bulletin No. 39, on analyses of the orange:

The samples of Riverside citrus fruits shown at the Citrus Fair March, 1885, with the exception of those marked *a* and *b* were received through the hands of Mr. Chas. H. Dwinelle, on his return from the fair. All were in excellent condition and were worked during the days following April 3d, the day of receipt.

The samples marked *a* and *b* formed part of a collection received some time afterwards, through the courtesy of Mr. J. E. Cutter, W. H. Backus, J. H. North and other exhibtors, of Riverside. They were

kept on shelves in a room until May 15th, when the Navel had lost some of its original firmness and the Malta Blood was begining to show shrinkage from drying.

These samples had therefore been keep six weeks longer than the others, but were in good condition. Four of the Navels still on hand at this date—May 22d—though soft to the touch are perfectly sound.

The data given in the table below explains themselves. Column No. 1 gives the average weight, in drams, of the fruit examined, usualy two in number; a division by 30 gives this weight in ounces avoirdupois. Column 2, 3 and 4 give the percentage of rind, pulp and seed respectively.

It will be noted that the Navel and Malta Blood oranges and Eureka lemon were found seedless, the largest proportion of seeds being found in the St. Michaels' orange. Column 5 gives the per cent of juice in cubic centimeters, referred to the weight of the fruit in grams; and since the density of the juice is somewhat above that of water, this percentage, if taken by weight, would be a little higher than here given; but for the practical comparison the figures hold good. Column 6 gives the actual amount of juice obtained per single fruit, again in cubic centimeters, which, by division by the number 30 may be reduced to fluid ounces. Column 7 and 8 give the percentage in the juice of cane sugar (sucrose) and fruit sugar (levulose), the sum of sugars being shown in column 9. Column 10, finally, gives the percentage of acid calculated as citric acid.

ANALYSES OF CITRUS FRUITS.

NAME.	1	2	3	4	5	6	7	8	9	1
	Average Weight in Grams.....	Rind. Per cent.	Pulp. Per cent.	Seeds. Per cent.	Juice. Per cent. c. cm.	Average Amount of Juice. c. cm.	Sugars. Cane. Per cent.	Sugars. Fruit. Per cent.	Total Sugar. Per cent.....	Acid. Per cent.
ORANGES.										
1. Mediterranean Sweet.....	288.0	33.5	65.6	0.9	.....	.....	4.47	1.67	6.14	1.10
2. Riverside Navel (a).....	283.7	30.0	70.0	.....	41.42	117.5	5.04	2.10	7.14	.92
3. Riverside Navel (b).....	.....	.....	.....	.....	.....	.....	4.47	1.96	6.43	.86
4. Paper Rind St. Michael....	158.0	17.3	80.1	2.6	52.58	82.7	4.09	1.68	5.77	1.01
5. Malta Blood (a).....	139.0	26.8	73.2	.....	48.55	67.5	3.92	1.81	7.73	1.52
6. Malta Blood (b).....	.....	.....	.....	.....	.....	.....	4.01	1.55	5.56	1.34
LEMONS.										
7. Lisbon.....	115.2	35.7	63.9	0.4	43.40	50.0	.....	.....	.....	6.79
8. Eureka.....	157.0	22.4	77.6	.....	45.22	71.0	.....	.....	.....	7.21
9. Limes.....	53.5	15.9	83.4	0.7	56.53	30.3	.....	.....	.....	6.86

1. Mediterranean Sweet orange, from W. H. Backus.
2. Riverside Navel orange, from John G. North. Taken from a plate of five oranges which received the first prize for the best budded orange and best orange on exhibition.
3. Riverside (or Australian?) Navel orange, from J. E. Cutter.
4. Paper Rind St. Michael orange, from W. H. Backus.
5. Malta Blood orange, grower not mentioned.
6. Same, grower not known.
7. Lisbon Lemon, from E. W. Holmes.
8. Eureka lemon, from same.
9. Limes, from W. H. Backus.

These analyses show some interesting and important points of difference between the several fruits. The Navel shows the highest total sugar and lowest acid of all; and this is true equally of the earlier and later samples, *a* and *b*. The Mediterranean Sweet stands next in sugar percentage;its acid is a little higher than that of the St. Micheals in absolute percentage, but the proportion between sugar and acid is practically identical in the two, the juice of the St Michaels being a little weaker in both substances. The Malta Blood is a little lower in sugar then the St. Michaels, but exceeds it in acid by 50 per cent in the earlier sample.

It thus would seem that, apart from its inviting outward appearance, the Riverside Navel owes its place in public favor to three chief points: A high degree of sweetness, with a low degree of acid, and the firmness of flesh which invites it to be actu-

ally eaten instead of "sucked" as one is tempted to do with the other softer oranges.

The Mediterranean Sweet and the St. Michael dispute precedence, according as indivdual tastes differ in respect to size and flavor; but the St. Michael seems to have a greater firmness of flesh in its favor. The refreshing acidity and peculiar flavor of the Blood orange place it in a different category from the other three.

The first six columns, however, furnish food for additional consideration, especially when oranges are sold by the piece or thousand and not by weight. The Mediterranean Sweet shows a slightly heavier weight then the Navel, but the larger proportion of pulp in the latter more then makes up for the difference. Owing to an accident, the proportion of juice to pulp was not determined in the case of the Mediterranean Sweet; in the Navel the figures show it to have been about 59 per cent, whereas in the St. Micheals it goes as high as 65.6, in the Malta to 66.3 per cent. The latter two are, therefore, quite materially more juicy than the Navel, hence more delicate in transportation.

The St. Michaels show the highest percentage of pulp of all, notwithstanding the relative abundance of seed; and hence a given weight of this variety would furnish the largest amount of eatable pulp, while if bought per thousand, the light weight of the fruit would leave the consumer materially "short" as compared with the Navel or Mediterranean Sweet. Comparing the earlier fruit with that analysed six weeks later, there is in the case of both the Navel and St. Micheal a decided decrease of both sugar and acid; exactly the reverse of what would have been looked for, as these ingredients might have been supposed to be concentrated by evaporation. There is therefore a true deterioration in oranges kept beyond the point of proper ripeness, that amply justifies the preference of consumers for the freshest fruit.

As regards the lemons, the comparison between the Lisbon and Eureka tells strongly in favor of the latter. It is larger and has a higher percentage of pulp as well as juice, while at the same time the latter is considerably richer in citric acid. Assuming 7 per cent as the usual average, it will be noted that the Eureka is nearly as much above it as the Lisbon is below. The limes stand nearly at the same point as the Lisbon, but show a considerable higher proportion of pulp as well as of juice then either of the two lemons, being fully 13 per cent above the Lisbon in the latter respect.

While these comparisons will probably hold good in general as between these varieties, the absolute figures (percentages) must be taken with allowance for the peculiarity of the season of 1884, with its unusual rains and low temperature. A reference to the analysis made in 1879 (see the report of the College of Agriculture for that year, pp. 59 and 60) shows a much higher average of both sugar and acid for the oranges and of acid for the lemons; the proportion of pulp also seems to have been higher throughout.

E. W. HILGARD.

Berkeley, May 22, 1885.

ANALYSIS OF THE ORANGE.

Composition of the ashes of the fruit:

Constituents.	Mineral Manure Per cent.	Compost. Per cent.
Potash	20.15	15.28
Soda	10.22	12.14
Lime	30.12	30.24
Magnesia	9.02	8.10
Phosphoric acid	20.04	18.24
Sulphuric acid	1.08	4.14
Silicic acid	4.50	5.82
Oxide of iron	4.25	4.75
Loss	0.62	1.29
	100.00	100.00
Ashes of the fruit	3.57	3.48

Composition of the trunk, branches and leaves:

	Trunks and Branches Per cent.	Leaves. Per cent.
Potash	14.15	10.18
Soda	10.67	10.82
Lime	31.57	41.22
Magnesia	10.64	6.53
Phosphoric acid	18.82	19.47
Sulphuric acid	4.89	4.53
Silicic acid	2.82	5.48
Iron and loss	6.44	1.77
	100.00	100.00
Azoe of the leaves	1.57	1.60
Ashes of the leaves	6.32	6.20

The orange trees above analyzed were from Alcira, (Valencia), Spain.

Part III.

LEMONS, LIMES AND CITRONS.

CHAPTER I.

LEMONS.

Lemon culture in California has not kept pace with orange culture. For this two reasons are assignable:

1st. The territory adapted to the growing of lemons is much restricted.

2d. The lemons mostly grown have been inferior, and the demand and compensation correspondingly small.

These obstacles are by no means insurmountable. Now that the suitable conditions for the lemon tree have been well defined by experience, the fact is evident that there are many locations—a large acreage—where the lemon may be successfully grown. As to the quality of the fruit, that may be improved just as all other fruits are improved—by the selection of fine varieties and their perpetuation by budding. Given a locality well suited to the requirements of the tree and a selected variety, and I challenge the citrus growing world to produce a finer lemon than we can grow in Southern California. Until five or six years ago no efforts were made to introduce fine varieties of this fruit. The kind universally grown was a Seedling from the Sicily lemon, and indeed at the present time these constitute the great bulk of the lemons on our market. This Seedling is a large, coarse-grained fruit, with a rind from a quarter to a half inch in thickness, a pulp inversely small, and the juice lacking in both quantity and quality. Such a lemon is a palpable fraud upon the purchaser, as it does not perform the half that it promises by its exterior bulk. It is undesirable for the shipper and merchant because it is quite perishable. The pulpy rind when subjected to a slight bruise or to too close packing is speedily smitten with decay, and the fruit is often lost in transit. When we consider that these lemons have too often been picked and packed in the most bungling and shiftless manner; that the sweating process previous to shipment has been almost wholly unknown or disregarded; that the fruit has reached the consignee many times in a rotten or semi-rotten condition, and that when presented at its very best it is a third or fourth class article; when we consider all these points we need not wonder that our lemon trade is in the doldrums.

The remedy for this condition of things is easy of accomplishment: Raise good fruit. Prepare and ship it properly. We may then sell all the lemons we raise and realize handsomely from this industry.

The lemon tree, being more susceptible to frost than the orange, is not adapted to our middle and lower lands, except in well sheltered quarters. It thrives however on our mesas, at an altitude of one thousand to two thousand feet above sea level, where frosts severe enough to damage it have never been known. There are thousands of acres of such land in Southern California, some already improved in fruit farms and much still awaiting development.

Discussing lemon culture in a paper read before the State Horticultural Society in 1883, Mr. L. M. Holt, one of our best authorities on citrus trees, has this to say:

"The climate must be such that the extreme cold shall not be hard enough to kill the trees or injure the fruit, and it must be of such a character that the common scale and the fungus known as black dust shall not flourish.

"When the mercury has been down to 23° above zero, the orchardist will find his lime trees killed, his lemon trees badly frosted, and his smaller orange trees hurt, especially if his budded orange trees are on lemon, China lemon, or lime roots.

"Cold weather produces a thick skin, a lack of juice, and in the case of the lemon a lack of acid. Climate, also, has much to do with the common scale and black dust. They prevail mostly along the coast valleys, and increase from San Diego

northward, while the interior valleys are more generally free from the pests. San Diego is effected but slightly. The interior valleys of Los Angeles county have less than the coast valleys, while San Bernardino county is entirely free from the black dust, and only occasionally has the scale.

"All new countries experiment with fruits by planting the seed, raising the tree and fruiting it. If successful, the culture is then commenced more systematically. This course was pursued with the orange and lemon. Seeds from the Sicily lemon were planted, and the fruit thereof was called the Sicily lemon. In this respect there is a wide difference between the orange and lemon, as the Seedling orange is a valuable fruit, while, as a rule, the Seedling lemon is worthless."

Conceding the fact that the area of possible production is much smaller for lemons than for oranges, and that the industry is less likely to be overdone than any other branch of citrus culture, it seems to me that lemon growing offers great inducements to the horticulturist who is rightly situated to engage in it. The character of the lemon as a fruit is also quite different from that of the orange, the former being more of a staple. Lemon juice enters largely into manufactured products—in citric acid and in cooking. The habit of the tree also in forming and maturing its fruit successively for several months of the year favors a long market. Under proper conditions the lemon tree is hardy, thrifty and a prolific bearer. It requires less water than the orange. These are all advantages worth considering.

The imported lemon sells in the leading markets at from $8 to $10 per box, or from $24 to $30 per thousand; the California lemon commands from $2.50 to $3 per box, or from $10 to $15 per thousand.

Why should not the California lemon, if raised to an equal standard with the imported fruit command an equal price?

In 1881 the importation of lemons to the United States amounted to 860,241 boxes, or a total of 301,084,352 lemons. For the ten years preceding 1881 there had been an average increase of 54,271 boxes annually. As long as this vast and increasing consumption continues, there *must* be a field for lemon growing.

CHAPTER II.

AN INVESTIGATION OF LEMONS AND LEMON CULTURE.

At the Citrus Fair, held in Riverside in 1883, a committee was appointed to make thorough scientific tests, for purposes of comparison of lomons grown in California and of some samples of the imported fruit. The committee was also instructed to consider the status of lemon growing in California, and to report upon the best means for the promotion of the industry. The committee made a valuable report, a portion of which is subjoined:

EXTRACT FROM THE REPORT OF THE COMMITTEE.

"To assist the growers of citrus fruits in Southern California in supplying the increased demand for the lemon, and to place the crops grown by them properly before the consumers of the Pacific Coast, was the object of this examination.

"That there is a very profitable field yet unoccupied by the growers of citrus fruits, is very clearly shown by the following statistics, gathered from the valuable report of J. H. Bostwick, upon the importation of green fruits into the United States for 1881 and preceding years.

"From this we find that in the years 1872 and 1881 the inportations were as follows:

	No. Boxes.	No. Lemons.
1872	317,532	111,136,200
1881	860,241	301,084,352

"An increase in ten years of 542,709 boxes and 189,948,152 lemons; an annual average increase of 54,271 boxes.

"It is a notabe fact that while the importation of the lemon has increased so rapidly, that of the orange, during the same time, has increased only half as much from all sources, and it is reasonable to suppose that this increase in the importation of the orange will be entirely checked within ten years by the great productiveness of the

growers of Florida, Louisiana, and California.

"The foreign lemon, always commanding the highest price in the San Francisco market, was adopted by the committee as a standard of comparison for the lemons grown in Southern California.

"Freshly imported specimens were secured from Messina, Malaga and Palermo, direct from Boston, through the liberality of Mr. H. B. Everest, and Messinas from Messrs. Dalton & Gray, of San Francisco, the latter having been picked some six months. All the specimens were in good condition.

"The lemons of Southern California were from all the important fruit-growing districts of this section, and from the fact that they were picked about the same time and cured in the same manner, the collection was the best in its average appearance and quality ever placed upon exhibition in the State.

"The following table shows the result of the analyses:

VARIETY.	Weight of lemons, drams	Amount of juic, drams	Per cent of juice	Per cent of acid	Amount of acid
Lisbon, average 11 tests	28.1	10.19	36.6	8.86	.89
Eureka, average 7 tests	25.25	9.33	37.0	8.81	.81
Sweet Rind, 1 test	34.0	10.12	29.7	8.77	.89
Knobby	17.5	6.0	34.2	9.15	.55
Imported Messina	26.5	12.0	45.2	8.19	.98
Imported Palermo	17.0	5.75	33.8	9.65	.55
Imported Malaga	21.5	7.0	32.5	8.29	.58

"The following points were adopted as a basis of comparison with the foreign lemons:

"First — Appearance, including size of lemon and quality of rind.

"Second—Bitterness.

"Third—Percentage of acidity.

"FIRST—APPEARANCE, ETC.—A lemon weighing about three ounces, when cured, of a bright golden color, with a smooth, soft rind, seems to be the favorite in the markets; and in all these respects the committee were unanimous in the opinion hat the budded lemons on exhibition for Southern California were fully equal to the best imported.

"The Sweet Rinds and most of the Seedlings, with an occasional Lisbon and Eureka, were above the standard size and weight. This will nearly always occur when the fruit is permitted to hang longer upon the tree than is necessary to mature it for market.

"It was noticed in the examination that the lemons of Santa Barbara, Ventura, Los Angeles, Anaheim and San Diego were nearly globular in form, and all having a smooth, morocco-like texture of the rind, while those of the same varieties found in San Gabriel and Pasadena were more elongated in form and not as smooth, and those of Riverside and vicinity were still more elongated and rougher in rind—a marked difference that must, in the opinion of the committee, be attributed to the differences in the temperature and humidity of the atmosphere in the localities named.

"It is noticeable that the smoothness and thinness of rind indicate greater quantity of juice, owing to the better development and cured state of the lemon. The extreme size does not show its proportional quantity of juice, but the medium sizes show the best averages.

"SECOND—BITTERNESS.—A bitter lemon is worthless for market purposes, and to the fact that so many of the *Seedling* lemons of California are bitter, is to be attributed, to a great extent, the low value of this lemon in the San Francisco markets.

"The test for bitterness, as adopted by the committee, was much more severe than that required of the lemon in ordinary use; yet the result was an exceedingly favorable one for the best budded varieties of our lemons.

"Out of forty-eight samples tested, thirty were entirely free from bitterness; seven showed only a trace, and eleven were decidedly bitter.

"We think, from this showing, it will not be difficult for our fruit growers to eliminate all traces of bitterness from the fruit grown here. To do this successfully the causes must be thoroughly understood, and the remedies, well known, as thoroughly applied.

"As a foundation for further and more

searching investigation, we offer the following suggestions as to causes:

"We are inclined to the belief that the stock has a great deal to do with the bitterness of the fruit. It is well known that the fruit of the Seedling Sicily lemon is, as a rule, bitter, as grown in Southern California, while the fruit grown from buds upon the sweet orange stock is generally more free from bitterness. Of the eleven varieties marked as bitter in the foregoing list, it will be seen that six are Seedlings, four are budded on the lemon stock, and only one was on orange stock.

"The condition of the fruit during growth will, to some extent, cause bitterness of the rind. If checked in its growth by lack or excess of moisture, or by cold, bitterness will result.

"Sample No. 12 is an evidence of this, as it is from a tree that last season produced fruit entirely free from bitternees, while this season the fruit was not fully grown and was imperfect when picked. [This sample tested above the general average in percentage of citric acid.]

"Again, we think that bitterness, like any other quality, can be transmitted through budding, and hence, when bitter fruit is found in successive years upon the orange stock, it is due to want of care in selecting stock to bud from.

"It is found also that fruit from young trees shows traces of bitterness that will gradually be lost as the tree increases with age. Occasionally this bitter principle appears in the imported lemon, and it is possible that it is found in foreign countries to the same extent as here, but that the period of picking and the curing process the fruit undergoes in the voyage here, removes it.

"THIRD—PERCENTAGE OF ACIDITY.—When freedom from bitterness is attained, the relative value of the lemon for commercial purposes will depend upon the percentage of acid it contains. In this respect the tests, as far as we were able to make them, showed the superiority of the Californian over the imported fruit. The highest percentage of the imported Messina was 9.65 of acid, while that of the California Lisbon reached 10.53, and another of the same species was 16.23, and two of the California Eurekas were respectively 10.33 and 10.43 per cent.

"The average percentage of acid in three tests made of the imported lemons gave 8.71 per cent., while that of nineteen tests of California budded lemons gave 9.04 per cent.

"It is a fact worthy of notice that the fruits giving the highest percentage of acid were specimens from the lomon bud upon orange stocks, showing the value of this stock for the lemon.

"From a careful analysis of the foregoing it will seem that the California budded lemon, properly grown and handled, is the equal in every respect of the imported lemon. Your committee is therefore forced to the conclusion that its want of appreciation in the San Francisco market is due from two causes:

"First—Unjust prejudice against California lemons generally.

"Second—Want of care in the producer, in packing and handling the fruit.

"That the first is true to some extent, is shown by repeated shipments of budded lemons from Riverside to the Denver market during the past winter, where they brought ten dollars per box; two dollars per box *more* than the best imported lemons, while the same varietieties would be sold at San Francisco for two and four dollars per box *less* than the imported lemon. It is fair to presume that the taste of consumers in Denver is as highly cultivated in this respect as that of the same class in San Francisco.

"Second—That there is deplorable carelessness in picking and handling this lemon is undoubtedly true, and to this cause may be attributed much of the loss that falls to individual producers, and to the trade generally. A prominent fruit grower of Riverside was in the city of San Francisco a few weeks since, and saw in the warehouses of one of the largest commission merchants there, a large number of boxes of California lemons. Upon examination he found them of all sizes, colors and shapes, tumbled into the boxes, without wrapping or care of any kind. The result was that they would either have to be sold at a price that would hardly pay freight and commission, or be stored for some weeks and then sorted

and repacked, at considerable cost to the owner, and possibly large loss of fruit.

"As an appendix to the above report, the committee would offer the following:

"RECOMMENDATIONS.—Discard all trees that, after a fair and repeated trial, continue to show bitterness of fruit.

"Exercise great care in the selection of varieties free from bitterness and rich in citric acid, from which to bud.

"Use the Seedling orange as a stock upon which to bud, as the orange is a hardier and healthier stock, and the lemon budded upon it is hardier than upon lemon stock.

"Keep your trees in a healthy, vigorous condition, especially during the fruiting season.

"The Lisbon and Eureka lemons are so far the most promising varieties, being productive, early bearing, of medium size, fine appearance, sweet rind and rich in acid.

"As the lemon can be kept from six to eight months after picking, if properly handled and cured, and will improve rather than lose in quality during that time, pick the fruit before it is ripe, or rather while a portion of the rind is green; store it for six or eight weeks in a cool, dry room, thoroughly ventilated, placing the fruit in thin layers on shelves or hurdles, where it can readily be examined and picked over if necessary.

"Avoid moisture during the process of curing. Sort when ready for maket, making at least two sizes or qualities, and pack none but perfect specimens, wrapping neatly in tissue paper, with the name of the variety and producer printed upon the wrapper, as a guarantee of good faith in the shipper.

"With these rules fully observed, we see no reason to doubt the prompt appreciation of California budded lemons in every market, and a complete check given to the importation of foreign lemons into California.

L. M. HOLT,
THOS. HENDRY,
H. J. RUDISILL,
G. W. GARCELON,
L. C. WAITE. } Com.

"W. N. MANN, Sec'y."

CHAPTER III.

LEMONS—PROPAGATION AND CULTURE.

Lemons are propagated in the same manner as oranges. It is unnecessary, therefore, to review the subject of propagation in this connection.

From what has been said in the preceding chapter, the inference is plain that there is little demand for seedling lemon trees. The only lemons worth cultivating are the choice budded varieties. Experience has demonstrated that the orange is a hardier stock than the lemon, and as it is believed that there is no deterioration of fruit by this conjunction, it has come to be a universal practice to grow lemons on orange roots.* The lemon has proven an unreliable stock upon which to bud the orange, as it exercises enough influence through the budded growth to render the fruit a bad orange and not a good lemon. The lemon stock in mature trees is quite susceptible to gum disease, especially if much irrigated. There is then no call for propagating lemon seed, except in the way of experiment.

What has been said about rearing budded orange trees in nursery applies equally to budded lemons, and almost the same may be repeated through the whole category of planting the trees, cultivating, pruning, freeing from insects, manuring and rejuvenating when worn out. There is in fact, the greatest similarity between these twin sisters in the citrus family—the orange and lemon. A novice would scarcely detect the difference in size and shape of tree, foliage and bloom, although there is an appreciable difference on close

*NOTE.—Dr. O. H. Congar, of Pasadena, a recognized authority on citrus culture, takes issue with this commonly accepted theory, claiming that the lemon deteriorates in budding upon orange stock. He holds that enough of the orange characteristics are incorporated to render the lemons of an ungainly size and to lessen the degree of acidity. It is possible that further years of experiment may demonstrate that Dr. Congar is measurably correct, and, if so, lemons will be budded on lemon stocks only, and oranges on orange stocks.

inspection. The wide divergence is manifested only in the fruit, and these are probably not the only twin sisters that have proven strangely sweet and sour.

In pruning lemons some of our most experienced cultivators favor a low growth, as they think that most nearly conforms to the natural habit of the tree. This was adverted to in the chapter on pruning.

CHAPTER IV.

BUDDED VARIETIES.

As the budded varieties of lemons are alone commended, it is in order to give a list of the kinds grown and a description of each. The list is scant, but it comprises some excellent varieties, any of which would redeem the character of lemon culture in California.

SWEET RIND.—This was the first improved variety originated here as a seedling. It is a fair lemon, but is excelled by others since introduced.

THE LISBON.—This was the first foreign variety introduced, coming from Australia. The tree is a strong grower, quite thorny, not so early in bearing as other varieties. Fruit oblong, symmetrical, strong acid; more or less seeds; rind sweet and thin. Acid rarely goes below 7 per cent, and frequently exceeds that standard.

THE EUREKA.—This is a chance seedling originated by Mr. C. R. Workman and introduced by Mr. T. A. Garey in 1877-8. The tree makes a vigorous growth, and is thornless. Fruit sharply pointed at blossom end, fair in texture, seedless and sweet rind; acid the best.

GENOA.—Imported from Italy. Tree thornless and an early bearer. Fruit good in all respects except acidity. Tests show the amount of acid to vary so much that the fruit is not looked upon with favor.

BONNIE BRAE.—This was originated by Mr. H. M. Higgins, of San Diego, from imported seed. I consider it the handsomest lemon grown in California. (See full description in succeeding chapter.) Tree of average size, a strong grower, quite thorny. Fruit symmetrical, texture the finest, rind thin, almost seedless, acid fair, and the juice possesses a peculiar rich flavor.

OLIVIA.—Originated by Mr. Geo. C. Swan, of San Diego. Tree somewhat thorny, good bearer. The fruit is excellent, test showing 8.08 per cent citric acid.

GARCELON'S KNOBBY.—A variety originated by Mr. G. W. Garcelon, of Riverside, and not yet introduced for general propagation. The fruit is small and peculiarly marked with a long spike at the blossom end. This variety possesses advantages which may make it a favorite at no distant day.

CHAPTER V.

PREPARING FOR MARKET.

The same general principles which apply to the handling of oranges apply to lemons. The fruit should be picked when dry and stored for a period during which it undergoes a sweating and curing process. In this way the excess of moisture is evaporated from the skin, rendering it soft and pliable, with a texture somewhat like a kid glove. Lemons cured in this way will keep a long time, and are not susceptible to decay in transit as the result of close packing or bruising. There is no secret about the curing process. The lemons are merely spread out

in thin layers in a dry, cool, well ventilated place and left anywhere from ten days to ten weeks, as suits the convenience of the grower. As the lemon ripens in midwinter, when there is little call for acid fruits, the advantages usually sought by the producer is to keep his fruit as long as possible before putting it upon the market.

In Florida, where the atmosphere is very humid, lemon producers have found it an advantage in curing their fruit, to fumigate it with sulphur to destroy the germs of fungus. The process has been tried here, but without satisfactory results. In our dry climate there is probably no better way to cure lemons than to arrange them so that they have shade and a plenty of air. Dr. Congar advises throwing the lemons in piles under the trees and leaving them there ten days or two weeks, when he says they will be most perfectly cured.

The most advanced shippers grade their lemons carefully and wrap them in papers for shipment. The packing boxes employed are the same as those used for oranges.

CHAPTER VI.

THE BONNIE BRAE LEMON.

I wish to call this variety into prominent notice, both because I believe it to be one of the finest lemons yet grown in California, and because it is a stranger and needs an introduction. My attention was first called to the Bonnie Brae by a plate of the fruit on exhibition in the Los Angeles Citrus Fair of 1880. So different was this fruit from other varieties of lemons on display that people were at a loss whether to class it as a lemon at all. The cut presented herewith, showing a group of Bonnie Brae lemons on a stem, is a correct representation, taken from life. The fruit is from medium to small, somewhat oblong, more abruptly rounded at the ends than ordinary lemons and possessing only slight protuberances at the blossom and stem ends. The texture of the skin is as fine as a kid glove, and when the lemon has seasoned a few days slight longitudinal corrugations appear as shown in the picture. The fruit is absolutely beautiful to look upon.

Various and repeated examinations have convinced me that it is as good as it is handsome.

The Bonnie Brae was originated by Mr. H. M. Higgins, of San Diego, from foreign seed. He contented himself, it seems, with budding a nursery of one hundred trees from the original stock, making no great effort to introduce the variety to public attention. In 1883 I purchased three of the trees from him, but, being poorly packed for shipment and delayed on the road, they were dried out and dead when they reached me. I made an effort to obtain others, but was too late, as Mr. Higgins had parted with his entire remaining stock, sending them to his brother in Lower California. In lieu of trees, however, he forwarded to me some buds from the original tree. These I passed over to a nurseryman and had them inserted in orange stock. I was fortunate enough to obtain therefrom one hundred and twelve thrifty trees, which are now growing on my place.

Since my correspondence with Mr. Higgins began, I have obtained two samples of these lemons—one in 1883 and one in 1884—and have subjected them to every test I could devise, with the most satisfactory results. The average size of the fruit is about eight inches in longitudinal circumference. The most notable features are its fine-textured skin, its bright color, and its unusual weight. Divided with a knife, the texture within is found to fulfill the promise of the exterior. The rind is not above a sixteenth of an inch in thickness, and when the lemon has been allowed to season some time it reduces to a mere wafer. The pulp is tender, melting and brimful of juice of fair acid character and rich flavor. The seeds, if any, are few and small. In both years that I tested the fruit I laid several lemons away in a drawer, where they remained up-

wards of eight months. Instead of rotting, they dried down to veritable lemon mummies, and the dessicated pulp still left a sharp acid taste on the tongue. This experiment demonstrated to my satisfaction the keeping qualities of the lemon.

GROUP OF BONNIE BRAE LEMONS.

In answer to an inquiry from me as to the origin of the Bonnie Brae, Mr. Higgins wrote, under date of August 14th, 1884, as follows:

"I saved the seed of the Sicily lemon, and from that seed I obtained all varieties, from the commonest citron up to this fine lemon, which we named after the place, 'Bonnie Brae.' You cannot tell the tree by its looks from any other lemon tree in the grove. It is not a lime in any sense of the word."

In the San Diego *Union* of March, 1882, I find quite a full description of Mr. Higgins's farm, in which the following occurs:

"The lemon trees number about four hundred—three hundred Sicily and one hundred Bonnie Brae. Mr. Higgins obtained his stock from the seeds of rotten lemons, all the best foreign varieties, having been saved and shipped to him by a fruit dealer in San Francisco. The Sicily lemons (we use the term in contradistinction to Bonnie Brae) are generally large, thin skinned and juicy, and of a fine flavor. But the Bonnie Brae is superfine. There is as much difference beween it and the ordinary lemon as there is between a common bronco and a thoroughbred horse. Mr. Higgins can give no account of this superior variety beyond the fact that the fruit first appeared on a solitary tree in his orchard. This lemon is more oblong than the ordinary variety, has a smoother, thinner skin, is seedless, has a larger percentage of juice and a richer flavor. This remarkable lemon is called Bonnie Brae by Mr. Higgins, after the name of his orchard home. Such a fine specimen of the citrus family has never been produced in any of the semi-tropic orchards of the world. It is an original product of San Diego coun-

ty, and testifies unmistakably to the superiority of the climate and soil of this locality. The orchard now contains quite a number of trees of the Bonnie Brae variety, budded on orange stock. There is no tendency to reversion, but, on the other hand, the fruit goes on steadily improving."

CHAPTER VII.

THE LIME AND OTHER CITRUS FRUITS.

The lime grows in Southern California with the same culture as the orange and lemon. It is a dwarf tree or shrub, according to training, and bears a small fruit about one-half or one-third the size of a lemon, and strongly acid.

The lime industry in California—if it may be thus dignified—is in *statu quo*. Some years ago these trees were planted to a considerable extent, but they proved very susceptible to frost and were mostly killed out. A grove of some size is to be found at the Sierra Madre Villa on the mesa, at an elevation of eighteen hundred feet above sea level. Here, being practically free from frost, the trees flourish and bear well.

No systematic effort has ever been made to improve the quality of limes grown here. The Mexican product is superior to ours, and being imported in large quantities, and at low prices, practically drives California limes out of the San Francisco market. Enough of the fruit is produced in Southern California to supply local requirements, but there is at present no stimulus for further plantations.

Some people align their places with lime trees which they trim close for a hedge. Thus shortened in the limbs thicken, making the foliage dense, and forming altogether a very pretty hedge-row. If, in a severe winter, they chance to be stricken by frost, the lateral branches may be cut away, when the stocks will put forth new growth and, in a year, the hedge is itself again.

Citrons are cultivated to a less extent even than limes. I may say, in fact, that they are only grown as curiosities. The same may be said of the Pumalo orange and Chinese lemon. All of these fruits are very large and thick skinned. When utilized, the rind is the valuable part, the pulp being either insipid or bitter. We are all familiar with the citron of commerce, which consists of the rind of the citron fruit, deprived of its essential oil and cured as a preserve or confection.

A few years ago a firm in San Francisco attempted the preparation of citron for the trade, and, to this end, purchased all the citrons, Chinese lemons, and Pumalo oranges that were available in our section of the State. But we heard nothing further from the venture, and it was probably a failure. There is no question, however, but that, with the proper process, the citron of commerce might be manufactured from our fruit.

Meanwhile, the Pumalo and its congeners, when allowed growing space, continue to load themselves down with fruit as large as foot balls. They are matters of wonder, and that is all. The best citrus goods are done up in smaller parcels.

APPENDIX.

INSECTS INJURIOUS TO CITRUS TREES,

[FROM THE WORK OF HON. MATTHEW COOKE.]

AND HOW TO COMBAT THEM.

CHAPTER I.

INSECTS INJURIOUS TO CITRUS TREES.

THE BLACK SCALE.

(*Lecanium oleæ*—Bernard.) Order, *Hemiptera;* sub-order, *Homoptera;* family, *Coccidæ.*

[A dark brown hemispherical scale insect, or bark-louse, which infests all varieties of citrus trees, and nearly all varieties of deciduous fruit trees, and many shrubs, vines, etc.]

The black scale is more generally found in the orchards and gardens of California than any other species of the *Coccidæ.*

It infests the orange, lemon, lime, olive, apple, pear, peach, apricot, plum, prune, cherry and pomegranate trees. In the garden it infests the honeysuckle, chrysanthemum, rose, oleander, and many other plants; and this, or a closely allied species, infests the forest trees. The presence of this species can be readily detected by the appearance on the branches, foliage and fruit of a black smut, known to scientists as *Fumago salicina,* and the cause of its production is a question upon which authorities differ. I am convinced, from practical investigation, and also from information received from Mr. Alexander Craw, and Mr. Wolfskill, of Los Angeles, and the late A. B. Clark, of Orange, Los Angeles county, that the black smut is caused by a honeydew exuded by the females of the black scale insect, in the stage of their life between the first formation of the calcareous secretion by which the insect is covered, and their reaching maturity or becoming fixed to any part of the plant.

In relation to this smut or fungus, Professor Barlow writes: "The result of our examination of the diseased orange and olive leaves is briefly as follows: The disease, although first attracting the eye by the presence of the black fungus, is not caused by it, but rather by the attack of some insect which itself deposits some gummy substance on the leaf and bark, or so wounds the tree as to cause some sticky exudation on which the fungus especially thrives. It is not denied that the growth of the fungus greatly aggravates the trouble already existing by encasing the leaves, thus preventing the action of the sunlight. We only say that in seeking a remedy we are to look further back than the fungus, itself, to the insect, or whatever it may be, which has made the luxuriant growth of the fungus possible.

The smut or fungus is found on the branches, foliage and fruit of orange, lemon, lime and olive trees infested by the black scale. I have also seen apricots and peaches, taken from trees infested by this insect, so thoroughly covered by this smut that it destroyed their market value for canning purposes.

NATURAL HISTORY.—The black scale when full grown is of a dark brown color, nearly hemispherical in form, but is slightly longer than broad; length, from two to two and a half lines*; width, about two-thirds of the length; height, one and one-half lines; there are two ridges or bars across the body, apparently dividing it into three parts, the middle being the largest; a short ridge along the back joins the two cross ridges, forming lines resembling the letter H; the edge of the covering of the insect resting on the wood, foliage, etc., is margined, and has a grooved or fluted appearance nearly one-half the height of the insect.

The eggs are ovai in form; when first laid, whitish; before hatching, a reddish yellow. From seventy-five to one hundred and seventy-five are deposited by each female of this species.

The larva is one-seventy-fifth of an inch long; width, five-eighths of length; form, oval; antennæ, six or seven jointed. From the time the secretions begin to form until

*A "line" as here used is one-twelfth of an inch

the insect has reached maturity, it assumes different shades of color — first, greenish brown; half grown, reddish brown, and at maturity, dark brown.

It is doubtful if there are more than one brood in each year. The first brood is hatched, in Sacramento, about the first of May, but do not attempt to leave from under the scale until the twelfth, yet it is very common to find thefemales of this species depositing their eggs late in September, but whether they are of the spring brood I am not prepared to say.

In relation to the length of time the lecaniums are capable of moving from one place to another, Mons. V. Signoret writes: "Before pregnancy they have the power to move, if necessary."

THE RED SCALE. (CAL.)

(*Aspidiotus aurentii*—Maskell.) Synonym, *Aspidiotus citrii* — Comstock. Order, *Hemiptera;* sub-order, *Homoptera;* family, *Coccidæ.*

[A circular reddish scale insect, infesting the citrus trees, and has been found on grape-vines and the foliage of walnut trees.]

The red scale infests some of the citrus groves of Southern California, and orange trees in Sacramento and Marysville. It has also been found on grape-vines and on the foliage of walnut trees, but I do not think that any damage will be done to these plants by this pest. As the walnut sheds its foliage annually, the insects are likely to be destroyed; and those which I have examined on the grape-vines in the month of September, and which appeared to be in a healthy condition, were dead and shrunken when I examined the vines in the month of February following.

It is generally conceded that this species is an importation from Australia.

NATURAL HISTORY. — Female scale, nearly transparent, circular, of a light-grayish color, and measures from one line to one and one-quarter lines in diameter; exuviæ or cast skin in center, yellowish; second larval skin easily distinguished.

Male scale, a little darker in color and smaller than the female scale; form, elongated; exuviæ nearest the anterior end.

Eggs.—It is thought by some writers that the females of this species are viviparous. I have watched the female insect ovipositing, and immediately examined the egg or sack under a microscope, using a high power, and could not detect any appendages; however, in twenty-four hours I noticed the presence of antennæ and legs. The insect produces from two to four of these eggs or sacks in twenty-four hours, and the number produced by each female is from twenty to forty-three; the latter is the highest number I have found.

In the month of September, 1882, I found a lemon at an orchard in Los Angeles county on which the larvæ of thirty-nine male scale insects had located around the stem of the fruit, and as there was only one matured scale on the lemon this was evidently the number produced by one female. Larva color, bright yellow; form, ovoid; length, one-eightieth of an inch; antennæ, six jointed; anal setæ, present.

Female: color, light or primrose yellow when the scale is formed, but as it reaches maturity it becomes a brownish yellow. The formation of the body is such that under the scale, when examined with a lense, its appearance is that of a broken ring, but when ovipositing the posterior end of the abdomen extends beyond the circular line of the body. The color of the natural insect is shown through the nearly transparent scale from which it derives its common name—Red Scale.

Male: color of body, amber yellow, with dark marking on thorax; eyes, black.

Female red scale insect: color, yellow.

The young larvæ can be found at all seasons of the year, and there are probably four or five broods in each year.

THE RED SCALE OF FLORIDA.

(*Aspidiotus ficus*—Riley, MSS.; *Chrysomphalus ficus* — Riley, MSS. Ashmead.) Order, *Hemiptera;* sub-order, *Homoptera;* family, *Coccidæ.*

[A species of scale insect infesting the branches, foliage and fruit of orange trees in Florida and the Island of Cuba.]

Professor Comstock describes this species as follows: "*Female Scale.*— Color, the part of the scale covering the second skin is a light reddish brown; the remainder of the scale is much darker, varying

from a dark reddish brown to black, excepting the thin part of the margin, which is gray; exuviæ nearly central, whitish in fresh specimens; form, circular, one line in diameter. *Male Scale.*—The scale of the male is about one-fourth as large as that of the female; the posterior side is prolonged into a thin flap, which is gray in color. (See United States Agricultural Report, 1880; and Ashmead on 'Orange Insects,' 1880."

THE LEMON-PEEL SCALE. (CAL.)

(*Aspidiotus nerii*—Bouche.) Order, *Hemiptera;* sub-order, *Homoptera;* family, *Coccidæ.*

[A whitish circular scale insect, infesting the lemon, plum, cherry and currant; also the oleander, acacia, magnolia, etc.]

This species has been known to scientists as the "Oleander Scale," from which it derives its specific name, *nerii.* Within the last four or five years it has been found on the lemon, plum, cherry and currant; also on the acacia, magnolia, etc. It seems to prefer the fruit of the lemon, and in many cases infests the skin or peel to such an extent as to reduce its market value. California cannot claim a sole proprietary right to this pest, as lemons imported from Europe are often offered for sale in our market which are seriously infested by *A. nerii.*

NATURAL HISTORY.—The female scale is of a whitish color, and nearly circular, measures one line in diameter; exuviæ or cast skin, yellowish, and near the center. Male scale, white, smaller and not as circular as that of the female. Egg, light yellow. Larva, yellowish white; length, one-eighty-fifth of an inch. Female, light yellow, with darker blotches; body, circular; abdominal segments appear as a pointed projection at one part of the circle. Male insect, winged; body, yellowish, with dark markings. The lemon-peel scale insect closely resembles the red scal, and it is only by the difference in color that a person not thoroughly acquainted with the respective species can distinguish them.

PERGANDE'S ORANGE SCALE. (CAL.)

(*Parlatoria pergandii*—Comstock.) Order, *Hemiptera;* sub-order, *Homoptera;* family, *Coccidæ.*

[A scale insect infesting the branches, foliage and fruit of citrus trees.]

I have found this species on the orange tree in Sacramento, but have not found it in any other part of the State.

The female scale is somewhat elongated in form, but nearly circular, the exuviæ at one side of the center; color, grayish; exuviæ yellow, and generally oval in shape.

The scale of the male is elongated and narrow; color, dirty white, exuviæ at the anterior end. Female—color, purplish, with posterior end of the body yellowish, and is nearly as broad as long. Eggs—color, purplish; elongated; from nine to twenty found under each female scale. Larva—length, nearly one-nineteenth of an inch; color, purplish. Male—color, dark purplish.

THE CITRUS LEAF AND FRUIT SCALE.

(*Mytilaspis citricola*—Packard.) Synonym, *Aspidiotus citricola*—Packard. Order, *Himiptera;* sub-order, *Homoptera;* family, *Coccidæ.*

[An elongated, slightly curved scale insect, infesting citrus trees.]

This species of scale insect has not been found on any of the citrus trees in this State, so far as I know, but it will be strange if it is not found in the near future. It is not a rare occurrence to find it on oranges, etc., which are imported from Europe, Australia and Tahiti, and offered for sale on fruit stands throughout the State.

The scale of this species is similar in form and appearance to that of the oyster shell bark-louse, excepting that it may be a little wider at the posterior end. Length of female scale, about one and one-half lines. The male scale is similar to other species of *Mytilaspis* in having a hinge-like joint, posterior to the middle of the scale, so that by lifting the posterior part up the perfect insect can emerge.

THE SOFT ORANGE SCALE. (CAL.)

(*Lecanium hesperidum*—Linnæus.) Order, *Hemiptera;* sub-order, *Homoptera;* family, *Coccidæ.*

[An oval flattened scale insect, infesting citrus trees, especially the orange.]

The soft orange scale is found in California in nearly every locality where citrus trees are grown. It infests the wood, foli-

age and fruit. This, or a closely-allied species, is found on plants in hot-houses.

Professor Comstock, in his Entomological Report of 1880, writes: "The male of this species has never been found, although it has been studied from the time of Linnæus down."

In September, 1880, I prepared a dry mounting of a specimen of *Lecanium hesperidum* for microscopic use at the State Fair of that year. Early in the week a small insect was noticed coming from under a specimen beneath the glass, and finally released itself. It proved to be a male scale insect.

NATURAL HISTORY.—Female—a broad, oval scale, measuring from one and one-quarter to one and one-half lines in length, widest at the posterior end; color, dark brown on top, and a lighter brown surrounding the margin. Two indentations on the margin on each side, and a large indentation on the posterior end. It has powers of locomotion similar to those of other *Lecaniums*. I have not found the egg of this species, but have found large numbers of the young larvæ—as many as forty-five under one specimen. The young larvæ appear about the first of May in the vicinity of Sacramento. Larva length, one-eighty-fifth of an inch; color, dark or dirty yellow; antennæ, six jointed (some specimens appear to have seven joints); two anal setæ.

DESCRIPTION. — Length of body, one-seventy-second of an inch; from front of head to apex of wing, one-twenty-fourth of an inch; posterior stylets, one-forty-fifth of an inch, or one-half the length of body; color, body, immaculate golden yellow; eyes, dark or black; antennæ (from the peculiar position in which they are placed I can only count seven joints), golden yellow and hairy; legs, golden yellow.

As it did not agree with the description of any of the male scale insects I had read of, or specimen males of *aurantii*, *perniciosus*, *perseæ*, *rapax*, *roseæ or purchasi* in my possession, I could only imagine that it was the male of *L. hesperidum* (be what it may, it came from under the *L. hesperidum* scale), and fortunately I preserved the mounting.

COTTONY CUSHION SCALE. (CAL.)

(*Icerya purchasi*—Maskell.) Order, *Hemiptera;* sub-order, *Homoptera;* family, *Coccidæ*.

[A white, cushion-like scale insect, feeding upon citrus trees, deciduous fruit trees, forest trees and on some varieties of vegetables.]

This species of scale insect I consider the most dangerous of any that infests fruit and other trees in California, as it may be said to be a general feeder. It is found on all varieties of citrus trees, deciduous fruit trees, on many varieties of ornamental trees, forest trees and shrubs; also on some varieties of vegetables. The apparent color of this scale insect at first sight is white, with a dark colored head. On examination it is found that the part indicated by the dark color is the insect, and the white portion a bag or case spun by the insect to conceal her eggs when deposited.

The females, after ovipositing (the egg case included), differ in size, some measuring six lines in length; but the general length is from three to four lines; width, one and one-half to three lines, and slightly tapering toward the posterior end. Each female deposits from two hundred to five hundred eggs. In one instance I counted seven hundred and three. The eggs are oblong-ovate in form, and of a pale red color.

Larva—color, body red; antennæ, six jointed, clubbed at the apex, on which are six long hairs—color, smoky black; legs, smoky black (the joints of the antennæ and legs are lighter in color than the balance); there are six long anal hairs; the margin of the body and back is also dotted with hairs; length of body, one-thirty-fifth of an inch.

The female insect during her growth assumes a variety of colors; principally yellowish red, with irregular blotches of white, green and yellow. At full growth, and before spinning egg case, she is ovoid in form. The hairs on the anal margin and sides are used as spinarets, exuding a cottony-like secretion, of which the egg case is formed. During her growth, and before beginning to spin her egg case, the females exude a honeydew, which forms a black smut on the branches and foliage,

as described under the head, Black Scale.

Male insect, winged; color, thorax and body dark brown, abdomen red; antennæ dark colored, with light brown hairs extending from each joint; wings brown, irridescent.

TREATMENT FOR SCALE BUGS.

[From the Bulletin of the Los Angeles Horticultural Commission.]

In all cases of infection from the white cottony cushion scale, it is recommended that the trees be thoroughly sprayed previous to any pruning. This plan is deemed the better one, because the danger of scattering and spreading the insects is much less than in the practice of cutting back or thinning out the trees previous to medicating. If properly and thoroughly used this first application will kill a considerable proportion of the bugs, many of which, if the trees were first pruned or cut back, notwithstanding the use of great caution and care in removing brush to the fire, would fall to the ground and seek adjoining trees or plants for food and breeding spots.

Use for spraying white scale, 35 pounds whale-oil soap, 4 gallons coal oil (110 fire test), to every 100 gallons of water. The coal oil must be made into an emulsion with the soap *first*, then add balance of soap and water, in the following manner: First, boil the soap in as little water as possible, as the soap must be thick to take up the coal oil and make a proper emulsion. When thoroughly dissolved and well boiled, place five gallons of this hot soap in an empty barrel, some distance from the boiling kettle, to prevent accident from fire; then add coal oil and churn vigorously for about ten minutes, with a stick with cross pieces about five inches wide at the end, forming a T. If the mixture at this time turns to a thick cream, pour in a little cold water—say two gallons—and churn again for a few moments; then add five or more gallons of water. Do not pour in water all at once, but a little at a time, and churn constantly while pouring in the water. This mixture, when properly emulsified, will form a whitish, creamy substance. The most particular attention must be given to making the emulsion properly, otherwise the oil, not being incorporated with the soap and water, will rise to the top, and while portions of the tree will receive an overdose of kerosene, other parts will get little else than soap and water. The result will be unsatisfactory, for the coal oil must go with the soap to do effectual work in killing the bug.

As soon as practicable after the first application, proceed to cut back and thin out the tree, burning the brush as near the tree from which it is taken as possible without danger of injury to it. A large canvas under the tree during the pruning will, if carefully disinfected at the finish, prove of considerable benefit. A band of rope, thoroughly smeared with coal tar, about the trunk of the tree, first putting a band of leather or thick cloth over which to tie the rope, will prevent the insect from ascending, and tend to indicate its presence and location for future treatment. Cases of ordinary infection can undoubtedly be cured if the above is carried out faithfully and to the very letter, and by keeping such close watch over the trees that the reappearance of the bug is at once followed by an application of the spray, before any time has lapsed for breeding and spreading. In aggravated cases of infection, where the bug has a strong hold upon the tree, topping, careful brush burning and hand scrubbing must be resorted to. But even in such cases the use of the spray at first would much simplify the work and lessen the danger of scattering and spreading the scale bugs. It is highly necessary to success that all weeds in the vicinity of infected trees should be carefully gathered up and burned.

For the red scale, July and August are the best months to spray in, as they hatch during May and June. Use thirty-five pounds of soap and three gallons coal oil to every one hundred gallons of water. If sprayed in September or October add five pounds of soap.

The best months to spray for black scale are September and October. They hatch through July and August. Use thirty pounds soap and two and one-half gallons coal oil to every one hundred gallons water. Thinning out and cutting away all surplus wood will do much towards relieving the trees from black scale. Care should be taken to strain the wash through fine wire cloth, otherwise frequent stops will be necessary to clear the spray nozzle.